

# 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 people as long as they 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 work of my students and colleagues that needs to be incorporated. 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.

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 3
- 1b Fungus an ascomycete; fruiting structures various but not mushroom-like
  - 2a Thallus GELATINOUS, black to brown or gray, photobiont blue-green except in two intertidal species..... Key B, Page 3
  - 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 5
        - 5b Fruiting structure apothecia, perithecia, or lirellae
          - 6a Fruiting structure elongate, narrow LIRELLAE, or ascocarps sometimes stellate or irregular ... Key D, Page 8
          - 6b Fruiting structures roundish ascocarps
            - 7a Peritheciate: Ascocarps forming PERITHECIA, or perithecia-like; black, flask-shaped ..... Key E, Page 9
            - 7b Apotheciate: Ascocarps forming APOTHECIA, or apothecia-like; disc shaped ..... Key F, Page 13
    - 4b Thallus STERILE (The sterile crusts are poorly known in the PNW, so the following key is quite incomplete)
      - 8a Thallus ORANGE, YELLOW, or yellow green..... Key G, Page 32
      - 8b Thallus another color
        - 9a Photobiont blue-green (cyanobacteria); thallus bluish gray; STERILE CYANOLICHEN CRUSTS ..... Key H, Page 35
        - 9b Photobiont green; thallus gray, white, cream, brownish, olive, etc.
          - 10a Thallus wholly LEPROSE ..... Key I, Page 35
          - 10b 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)
            - 11a On BARK OR WOOD or bryophytes over bark or wood..... Key J, Page 37
            - 11b On ROCK or bryophytes over rock ..... Key K, Page 45
  - 3b MACROLICHENS (thallus squamulose, foliose, or fruticose)
    - 12a Thallus SQUAMULOSE..... Key L, Page 47
    - 12b Thallus foliose or fruticose
      - 13a Thallus FOLIOSE, with dorsiventral lobes (if ± crustose with marginal lobes, key as crustose or squamulose)
        - 14a Thallus UMBILICATE (with central holdfast), on rock..... Key M, Page 50
        - 14b Thallus not umbilicate, more broadly attached, or if centrally attached then not on rock
          - 15a Primary photobiont blue green (STRATIFIED CYANOLICHENS); upper surface usually some shade of dark gray, brown, or black..... Key N, Page 52
          - 15b Primary photobiont green (look for grass GREEN ALGAL layer); upper surface variously colored ..... Key O, Page 55
      - 13b Thallus FRUTICOSE, only rarely with dorsiventral lobes
        - 16a Thallus BLACKISH FILAMENTOUS, prostrate or erect, minute or large ..... Key P, Page 61
        - 16b Thallus not of black filaments; color various
          - 17a Thallus of HOLLOW STALKS (podetia) that are ± round and pointed or tipped with apothecia or cups ..... Key Q, Page 63
          - 17a Thallus not of hollow stalks (either not stalked or not hollow); OTHER FRUTICOSE lichens ..... Key R, Page 65

## 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

*Omphalina*  
(= *Botrydina*)

1b Fruiting body short, clavate, pinkish brown, yellowish, tan, or whitish; thallus granular or membranous; widespread, occasional

*Multiclavula*

## Key B: GELATINOUS, BLACKISH, NONFILAMENTOUS

Thallus gelatinous, non-stratified (homoimerous); black to brown or gray, photobiont mostly blue-green

1a Plants aquatic or in rocky intertidal areas

2a Plants in freshwater; photobiont blue green

3a Lobes 2-15 mm broad, loosely attached; lower surface veined; thallus foliose, with medium-sized lobes (gen 2-15 mm broad); ascocarps apothecia; locally common in Cas, rare in RM, typically in small spring-fed streams having little fluctuation in water level

*Peltigera hydrothyria* (J. Russell) Miad. & Lutzoni  
(= *Hydrothyria venosa* J. Russell)

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

*Leptogium rivale* Tuck.

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 Island to s BC; also on coasts of Chile and Siberia

*Kohlmeyera complicatula* (Nyl.) Schatz  
(= *Turgidosculum c.* (Nyl.) Kohlm. & Kohlm.)  
(= *Mastodia tessellata* Hook. f. & Harvey)

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; Queen Charlotte Strait to Monterey, Cal

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

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

5a Thallus umbilicate, small (gen < 1 cm wide), often finely granular isidiate; spores nonseptate; on rock

6a Thallus monophyllous, the upper surface divided by ridges; photobiont of the *Chroococcus* type (algal cells uniformly large, 1-2 cells per thick gelatinous sheath); apothecia sunken, appearing closed; on occasionally wet siliceous rock

*Phylliscum demangeonii* (Moug. & Mont.) Nyl.

6b 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

7a Apothecia with expanding disks; thallus small umbilicate to squamulose or crustose

8a Thallus blackish, umbilicate to squamulose, often shallowly lobed; coast range of Oregon to Cal;

- poorly known
- Anema**
- 8b Thallus red-brown, granular-crustose or granular-squamulose; on rock or alpine sod
- Euopsis**  
(*Pyrenopsis* is similar but has punctiform disks)
- 7b Apothecia with sunken disks with punctiform openings; thallus umbilicate, often deeply lobed
- 9a Rosettes often crowded and turf-like; lobes to 3 mm wide, irregularly divided, the lobe ends shell-like
- Gonohymenia nigritella** (Lett.) Henssen
- 9b Rosettes gen separate, deeply divided; lobes variable in width, form, and degree of division
- Thyrea pulvinata** (Schaer.) Mass.  
also ***T. pyrenoides*** (Nyl.) Fink?
- 5b Thallus not umbilicate, small or large, isidiate or not; spores septate or not; substrate various
- 11a Thallus granular, minutely squamulose, crustose, or minutely fruticose
- 12a 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**
- 12b Thallus granular to obscurely squamulose or fruticose; photobiont various; spores nonseptate or septate
- 13a Photobiont filamentous (*Calothrix* or *Nostoc*); spores nonseptate or septate
- 14a Photobiont filaments not distinctly beaded, *Calothrix*; on rock; spores nonseptate. Colorado
- Porocyphus**
- 14b Photobiont distinctly beaded, *Nostoc*; substrate various; spores 1-septate to muriform
- Collema**
- 13b Photobiont colonial single-celled, nonfilamentous (*Gloeocapsa* or *Chroococcus* type); spores nonseptate
- 15a Photobiont *Gloeocapsa/Xanthocapsa* type (cells in colonies of 2-8 with thick sheaths, the sheaths at the margin generally yellow to yellow brown, the vesicles often packed into one another); on calcareous rock and soil
- Psorotichia**
- 15b Photobiont *Chroococcus* type (cells in colonies of 2-4 with a clear, thin, uniform sheath); mostly on wet rock; two species reported from Colorado, but undoubtedly more widespread
- Pterygiopsis**
- 11b Thallus foliose or fruticose
- 17a Spores nonseptate; thallus tiny; upper cortex of interwoven hyphae
- 18a Apothecia lacking thalloid margin; thallus granulose to subfruticose
- Leciophysma**
- 18b Apothecia with thalloid margin; thallus of flat, interlaced lobes with fruiting warts, small knobby clusters, or fruticose with cylindrical branches; widespread, rare
- Lempholemma**
- 17b Spores septate; thallus tiny to large; upper cortex various
- 19a Thallus without a cortex, the upper surface of interwoven hyphae (whole-thallus mount viewed from above through compound microscope. Note, however, that the thalline exciple is often corticate); thallus often dull, black or olive-black; widespread, common
- Collema**
- 19b Thallus with a cellular cortex, gen of ± isodiametric cells; thallus often faintly shiny, brown, gray or black
- 20a 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 *Scytonema*; widespread, fairly common in moist to arid environments
- Leptochidium albociliatum** (Desm.) Choisy
- 20b Hairs lacking on upper surface or if present then spores muriform; photobiont *Nostoc*

21a Spores 2-celled; thallus fruticose with terete branches, richly branched

*Polychidium*

21b Spores > 2-celled; thallus fruticose or foliose, habit various

22a Thallus of small, rust-brown, warty rosettes, with marginal lobes < 0.6 mm wide; spores 4-7 celled, 26-46 x 5-6 µm; growing on mosses or lichens; arctic-alpine s to OP; rare

*Arctomia interfixa* (Nyl.) Vain.

[*Arctomia delicatula* Th. Fr. was reported from BC by Noble et al. (1987), but this is based on a misidentification of a specimen containing a mixture of *Placynthium asperellum* and a *Leptogium* (Goward et al. 1994).]

22b Thallus small or large, various in form; spores parallel septate or muriform; widely distributed and common

*Leptogium*

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

1a Mazaedia or fruiting bodies on slender stalks, or the length of stalk gen > width of mazaedium

2a Stalked bodies are pycnidia or synnema (a group of erect and fused conidiophores or hyphophores)

3a Stalked bodies are pycnidia and contain long, slender, septate conidia; apothecia non-mazaedial but forming *Calicium*-like stalked fruiting bodies; often associated with *Stigonema*-like cyanobacteria in addition to green algae; apothecia unknown; thallus clearly visible, thin, granulose, grayish yellow-green to olive brown; hyperoceanic areas from BC to OP; on bark of *Alnus*, *Picea*, *Populus*, etc; (Acta Bot. Fenn. 150:1)

*Micarea clavopycnidiata* Brodo & Tønsb.

(Other species of *Micarea* in the PNW also form stalked pycnidia.)

3b Stalked bodies are synnema or hyphophores

4a On rock. Stalk shiny black; spore mass brown, appearing like a minute *Chaenotheca brunneola*; stalk about 0.2 mm long, 25 µm diam at base, 20 µm near head; spore mass ca. 70 µm wide, spherical to slightly elongate; spores spherical, brownish, papillose, about 7 µm diam; thallus thin or not apparent, membranous to slightly verrucose; apparently lichenized with chlorococcoid algae (McCune 25760, in *Picea sitchensis* forest on Oregon coast; also seen in Cascade Range)

**unknown calicioid**

4b On moss, bark, or wood

5a Stalked bodies are hyphophores

*Gyalideopsis*

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

5b Stalked bodies are synnema

6a On conifer twigs; lichenized. Stalks 1-2 mm high and 60-145 µm thick at the base and tapering to 24-40 µm near the head; conidial head 60-115 µm wide; conidia are elongate, multiseptate, very slender phialospores, about 60-120 x 1.5-2 µm; thallus of hyphal strands intimately associated with roundish green algae; on conifer twigs in rainforests of BC and Alaska

*Microlychnus epicorticis* Funk

(Other synnematous fungi, sometimes in apparent association with algae, have been seen in the PNW, but these are poorly known.)

6b 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 µm)

*Metacapnodium*

2b Stalked bodies are apothecia

8a Spores simple

- 9a Spores spherical  
 10a Mazaedium brown; spores brown  
***Chaenotheca***
- 10b Mazaedium pale; spores pale  
 11a Stalk pale, often light yellow; thallus endophloedal; photobiont *Trentepohlia*  
***Sclerophora***  
 (Spp reported from the PNW include *S. nivea* (Hoffm.) Tibell, *S. amabilis* (Tibell) Tibell, *S. coniophaea* (Norm.) J. Matts. & Middelb., and *S. peronella* (Ach.) Tibell.)  
 (= *Coniocybe* n., *C. pallida*)
- 11b Stalk black or greenish yellow; thallus various; photobiont not *Trentepohlia*  
 12a Stalk greenish yellow; on soil in sheltered sites (beneath undercut banks, on tip-ups)  
***Chaenotheca furfuracea*** (L.) Tibell  
 (= *Coniocybe* f.)
- 12b Stalk black  
***Coniocybe***
- 9b Spores ellipsoidal or cylindrical  
 15a Spores cylindrical, nonseptate or with 1-3 indistinct septa  
 16a Mazaedium dark, greenish tinged  
***Microcalicium arenarium*** (Hampe ex Mass.) Tibell  
 (= *Coniocybopsis arenaria*)
- 16b Mazaedium brown; esclipse generally yellowish pruinose  
***Chaenotheca laevigata*** Nadv.
- 15b Spores ellipsoidal or spherical, nonseptate  
 17a Thallus not lichenized; ascocarps black, cylindrical, with a submedian ascigenous swelling (similar to a bowling pin), the spores extruded from the tip in a mazaedium; on bark, especially *Populus*; resembling but not truly in the Caliciales  
***Caliciopsis calicioides*** (Ell. & Ev.) Fitzp.
- 17b Thallus often lichenized; stalk without a swollen lower or middle section  
 18a Apothecia extruding a brownish spore mass (mazaedium)  
***Chaenotheca***
- 18b Apothecia black, not forming a thick spore mass  
 19a Stalks whitish; hypothecium and stalk K+ green (LM)  
***Chaenothecopsis viridialba*** (Kremp.) A. Schmidt
- 19b Stalks black; hypothecium and stalk K-; thallus mostly endoxylic, not apparent, probably not lichenized  
***Mycocalicium subtile*** (Pers.) Szat.
- 4b Spores septate  
 24a Apothecia without a well-developed mazaedium  
 25a Mature spores < 10 µm long; asci 35-45 µm long  
***Chaenothecopsis***
- 25b Mature spores > 10 µm long; asci 70-100 µm long  
 26a Spores 1-septate or nonseptate  
***Phaeocalicium***
- 26b Spores 3-or more septate  
***Stenocybe***
- 24b Apothecia with a well-developed mazaedium  
 28a Mazaedium black; mature spores dark brown, ellipsoidal, 1-septate, the septum distinct  
 29a Stalks unbranched, very fine, < 0.5 mm diam; mainly on bark and wood  
***Calicium***
- 29b Stalks branched, erect, 0.5-2 mm diam and 2-20 mm tall; on rocks, rarely wood; widespread but rare; BC, Mexico, Asia, and southern hemisphere  
***Acroscyphus sphaerophoroides*** L veill 
- 28b Mazaedium dark or brown; spores with 1-3 indistinct septa, ellipsoidal-cylindrical

30a Spores light brown; exciple yellow pruinose

*Chaenotheca laevigata* Nadv.

30b Spores pale, with a greenish tinge; exciple not yellow pruinose

*Microcalicium arenarium* (Hampe ex Mass.) Tibell

(= *Coniocybopsis arenaria*)

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

35a Mazaedia sessile or immersed in the thallus

36a Spores with a very thick cellular-appearing wall, obscuring the internal septation; mazaedium with a fine but distinct yellow-green edge (calycin); rare on soil in dry, open habitats; Idaho, Oregon to San Diego

*Texosporium sancti-jacobi* (Tuck.) Nadv.

36b Spores without a thick cellular covering; habitat otherwise

37a Mazaedia immersed in distinctly protruding areoles; lateral part of exciple very thin and hyaline; spores 0-1-septate; fenceposts and other bare wood, exposed sites, also on other substrates in Cal

*Thelomma*

37b Mazaedia immersed in flat to bullate areoles; lateral part of exciple dark brown or black and well developed; spores 1-septate or submuriform; widespread, common on wood and bark

*Cyphelium*

35b Mazaedia on broad-based, short stalks or on short hollow podetia

38a Mazaedia on short hollow podetia. Spores 1-septate; uncommon w Cas; on twigs, mainly subalpine conifers but occasionally at lower elevations and occ on angiosperms (e.g. *Betula*)

*Tholurna dissimilis* (Norm.) Norm.

38b Mazaedia on broad-based short stalks

39a Mature spores pale green-brown, 0- to 3-septate, cylindrical; thallus indistinct, not lichenized

*Microcalicium disseminatum* (Ach.) Vain.

39b Mature spores dark brown, ellipsoidal to barrel shaped or ± cylindrical, 1-septate; thallus distinct; common and widespread

*Cyphelium*

## Key D: CRUSTOSE, APOTHECIA LIRELLAE OR IRREGULAR

### 1a Spores simple

2a Exciple dark brown to black throughout; hymenium often with lengthwise partitions of dark sterile tissue; on wood w Cas, Wash and Oregon

*Ptychographa xylographoides* Nyl.

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

3a On wood; thallus mainly within the substrate; outer surface of apothecium pale or brown. Apothecia elliptical to elongate, pale brownish or dark; common on wood, mainly w Cas

*Xylographa*

3b On rock; thallus areolate, whitish to pale gray-brown; outer surface of apothecium black, carbonaceous, brittle. Apothecia black, almost rounded or short lirellate, simple, straight to slightly curved; disk slit-like, not opening; exciple dark brown, well developed; paraphyses branched, soon disappearing; medulla K+R (norstictic acid); on moist siliceous or basic rocks, especially basalt, in open, exposed sites; widespread arctic-alpine, in PNW from Bering Strait to Queen Charlotte Islands

*Lithographa tesserrata* (DC.) Nyl.

### 1b Spores septate

#### 4a Spores muriform

5a Apothecia round to irregular; common on hardwoods w Cas

*Arthothelium*

5b Apothecia linear; occasional on hardwoods in Coast Range. Similar in external appearance to *Graphis scripta*, but apothecia are often longer and/or broader, sometimes pruinose; spores ca 44 x 16-18  $\mu\text{m}$ ; exciple brown black; epithecium dark brown; hypothecium light yellowish brown; thallus K+Y-O, UV  $\pm$  weak Y

*Graphina*

#### 4b Spores parallel-septate or 1-septate

6a Excipuloid margin present, usually carbonaceous

7a Spores 1-septate, constricted, colorless or finally darkening, 12-20 x 8-13  $\mu\text{m}$ ; apothecia angular to short-lirelliform; thallus white to gray; tentatively reported from Rocky Mountains in BC; Mycotaxon 28:106)

*Poeltinula cerebrina* (DC.) Haf.

7b Spores 3 or more septate

8a Exciple pale, similar in color to the thallus; spores 3-septate. Queen Charlotte Islands

*Graphis insidiosa* (C. Knight & Mitt.) Hook.

8b Exciple dark brown black, olive black, or carbonaceous; spores 3- or more septate

9a Spore walls thickened to form lenticular or rounded lumina, 7- or more septate; common w Cas, more rarely inland, on bark of broad-leaved woody plants (especially conspicuous on *Alnus*)

*Graphis*

9b Spore walls not markedly thickened, with cylindrical lumina; 3 to 5 septate; common on hardwoods w Cas; a few species are known from rock (e.g. *O. zonata* Körb. in Aptroot 1996); a number of species are non-lichenized (such as *O. thelotrematis* on *Thelotrema lepadinum*)

*Opegrapha*

6b Excipuloid margin absent

10a Spores 5-6 septate with one end cell much enlarged; common on bark, especially *Alnus*, coast range and immediate coast

*Arthothelium ilicinum* (Tayl.) P. James

10b Spores with fewer septa or without a conspicuously enlarged end cell; widespread, on various substrates

*Arthonia*

## Key E: CRUSTOSE, PERITHECIA

- 1a Photobiont blue-green (cyanobacteria) or a brown alga; on rock or barnacles
- 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; see Peters, A. F. and R. L. Moe. 2001. Bull. Calif. Lich. Soc. 8:41-43.
- Verrucaria tavaresiae* R. L. Moe
- 3b Photobiont cyanobacteria; ascospores 1-2-celled
- 4a On barnacles and other sessile intertidal organisms; perithecia sunken in blackish granules; spores 1-2-celled; very common
- Pyrenocollema halodytes* (Nyl.) R. C. Harris
- 4b On rock; thallus rosette-forming, thin, bearing irregular black warts and ridges, the ridges radiating and flattened at the margins; Cal coast
- [*Pyrenocollema elegans* R. Sant.]
- 2b Other habitats; on rock; ascocarps actually perithecia-like apothecia
- see *Pyrenopsis* and *Euopsis* below
- 1b Photobiont a green alga (but various in color, including reddish, yellowish, brownish, and green); substrate various
- 4a Spores simple
- 5a Spores small, 50-300/ascus; ascocarp an apothecium with narrow opening (perithecioid); on decaying organic matter, rock, rotten wood, and lichens (esp. *Peltigera*, *Solorina*, and *Baeomyces*)
- Thelocarpon*
- 5b Spores larger, 8 or fewer per ascus; ascocarp a true perithecium
- 6a 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*
- 6b Ascocarp with a brown, dark brown, or black wall
- 7a Paraphyses persistent, distinct; on soil. 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* (Pers.) Wallr.
- 7b Paraphyses disintegrating; mostly on rock. Widespread and abundant on wet rocks in and near streams and lakes; some species are found on rock in dry habitats; a few species occur on bark
- Verrucaria*
- (See numerous additions to the PNW by Brodo (1995, Mycotaxon 56:163))
- 4b Spores septate to muriform
- 8a Spores muriform; paraphyses or paraphysoids often disintegrating or lacking (but paraphyses often present)
- 9a Hymenial algae lacking; spores hyaline or brown
- 10a Thallus crustose, poorly developed or not apparent
- 11a On bark, mossy bark, or rock
- 12a On calcareous and siliceous rock in many habitats, including alpine and shaded forest floor; spores hyaline or brown; rarely collected and inconspicuous
- Polyblastia*
- 12b On bark or mossy bark.
- xa 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; so far known from a single site, on flood-scarred base of *Alnus rubra* near N Santiam River, Linn Co., Oregon.

*Agonimia allobata* (Stizenb.) P. James  
(= *Polyblastia allobata* (Stizenb.) Zach.)

xa Spores > 35 µm long

ya 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 Picea twigs on ocean cliff (McCune 26253)

*Thelenella modesta* (Nyl.) Nyl.

yb 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; paraphyses simple; asci cylindrical; spores 2/ascus, to 100 x 30 µm; on bark and mossy bark, coastal BC and Olympic Peninsula

*Topeliopsis toensbergii* Vezda & Kantvilas

[see Vezda & Kantvilas (2000), Lichenol. 32:325-357 and Bruess (2000), Evansia 17:90]

11b On mosses or lichens; spores hyaline or pale greenish

13a Ascus tip I-; photobiont chlorococcoid; steppe habitats (var. *octospora*) and west side (var. *muscorum*); on lichens, mosses over tree bases, rock, and soil

*Chromatochlamys muscorum* (Fr.) Mayrh. & Poelt  
(= *Microglaena muscorum*)

(var. *muscorum* has spores 60-90 x 15-25 µm and 2-4 per ascus; var *octospora* (Nyl.) Mayrh. & Poelt (= *Pyrenidium octosporum* Looman) has spores 40-60 x 12-20 µm and 8 per ascus.)

13b Ascus tip I+B; photobiont *Elliptochloris*; damp habitats in mountains to alpine; Wash and BC

*Protothelenella*

(Two species reported so far: *P. leucothelia* and *P. sphinctrinoides* (Bryol. 99:445); *P. sphinctrinoidella* (Nyl.) Mayr. & Poelt reported from 3000 m in Arizona (Bryol. 101:97))

10b Thallus squamulose, 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

*Agonimia*

9b Hymenial green algae present, included within the perithecium; spores brown

15a Thallus squamulose, on soil or rock; widespread, fairly common in arid areas and outcrops in RM

*Endocarpon*

15b Thallus crustose, fairly common on rock in many habitats; widespread

*Staurothele*

8b Spores cross septate only, without lengthwise septa

16a Ascomata containing multiple locules (perithecia)

*Tomasellia americana* (Willey) R. C. Harris

(Reported from BC, on *Sorbus* bark in Vancouver (Aptroot 1996). See Harris (1975) for description. Not a lichen according to Harris (pers. comm. 1996).)

16b Ascomata containing a single locule

17a Spores brown or dark brown

18a Spores 3-7 septate

19a Spore walls thickened, producing diamond-shaped or lens-shaped lumina. Thallus tan, cream, or olive tan, smooth, shiny, UV+ yellow-white; spores 16-22 x 7-9 µm; spore walls thickened, producing diamond-shaped or lens-shaped lumina; perithecia covered by a shiny black involucrellum, to about 0.7 mm diam; some apothecial tissues K+ magenta under LM; very common on hardwoods and shrubs, especially *Alnus rubra*, w Cas

*Pyrenula occidentalis* (R. C. Harris) R. C. Harris

19b Spore walls only slightly thickened, lumen ± cylindrical, not lens- or diamond-shaped

*Eopyrenula*

(Two species are reported from the PNW. *Eopyrenula parvispora* Harris & Aptroot (Aptroot 1991, 1996) has spores 13-17 x 4-5 µm; occurs on *Alnus*, other hardwoods, and *Pinus* near the coast; and is so far known from Alaska south to Oregon. *E. intermedia* Coppins has spores (4)5-6(7)-septate, 20-27 x 6-9 µm, and is reported from *Alnus rubra* in BC (Aptroot 1996, Bryol. 99:196).)

18b Spores 1-septate, 20-22 x 8-10 µm; apothecia perithecia-like or with a broader opening and lecideine in appearance; BC

*Lichenothelia unknown* #1

(See Noble, 1982 for a description of this species)

17b Spores hyaline or pale brownish (sometimes very old spores browning)

21a Spore walls conspicuously thickened to form diamond-shaped to rounded lumina, the end lumina close against the ends of the spore

*Pyrenula occidentalis* (see above)

21b Spore walls not conspicuously thickened

22a Spores 5-septate or more long and slender (>4X long as wide), > 25 µm long,

23a 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

*Trichothelium guentheri* (Flot.) R. C. Harris)

(= *Pseudosagedia guentheri* (Flot.) Haf. & Kalb)

(= *Porina guentheri* (Flot.) Zahlbr.)

[Harris 1995 noted the very broad application of this name; reported spore sizes are quite variable]

23b Substrate bark, moss, or soil

24a Spores not constricted, 28-38 x 4-6.5 µm, generally 6-celled; mature perithecia with flattened apex, becoming almost disk-like as the covering layer is shed. Thallus gray-green; reported from Colorado

*Gongylia muscorum* Zsch.

24b 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; paraphyses simple to sparingly branched, persistent photobiont *Trentepohlia*; on bark of hardwoods, mossy tree bases, or exposed tree roots; Queen Charlotte Islands (Brodo 1995)

*Strigula stigmatella* (Ach.) R. C. Harris

22b Spores 1-4 septate, relatively broad (usually ≤ 4X long as wide)

27a Paraphyses disintegrating, not recognizable in mature fruits

28a On bark

29a Spores > 25 µm long; paraphyses gelatinizing. Spores 1-septate (sometimes 3-septate with age), slightly constricted at the septum; frequent on *Alnus* and other hardwoods w Cas

*Mycoporum antecellens* (Nyl.) R. C. Harris

(= *Arthopyrenia antecellans* (Nyl.) Müll. Arg.)

29b Spores < 25 µm long; paraphyses gelatinizing or persistent. Spores 14-21 x 4-6 µm, 1-septate, constricted at the septum or not, one cell broader than the other; not a lichen according to Harris (1995); fairly frequent on *Alnus* and other hardwoods w Cas

*Naetrocymbe punctiformis* (Pers.) R. C. Harris

(= *Arthopyrenia padi* Rabenh., = *Arthopyrenia punctiformis* auct. non Massal.)

28b On rock or soil

31a Parasitic on soil-dwelling crustose lichens in 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), 14-17 x 3.5-5 µm; not lichenized

*Muellerella pygmaea* (Körber) Hawksw.

31b On rock

*Thelidium*

27b Paraphyses (or paraphysoids or pseudoparaphyses) persistent, not disintegrating

33a On soil or rock

34a Thallus yellow-green, on soil. Thallus UV+ (rhizocarpic acid), warty-squamulose but without cortex; spores 15-21 x 4.5-6 µm; on acid soil, alpine; Colorado

*Neonorrlinia trypethiliza* (Nyl.) H. Sydow

34b Thallus otherwise, on rock

35b Spores 3-septate. 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; spores 16-25 x 4-6 µm; on acidic rock, fully exposed or deep shade, often in the supralittoral zone or ± permanently inundated; BC

*Trichothelium chloroticum* (Ach.) R. C. Harris

(= *Pseudosagedia chlorotica* (Ach.) Haf. & Kalb, *Porina chlorotica* (Ach.) Müll. Arg.)

[The three species included here under *Trichothelium* (*aenea*, *chlorotica*, and *guentheri*) are included here under *Pseudosagedia* by some authors (Hafellner & Kalb 1995) and in *Porina* by others (Purvis et al. 1992). Inclusion of these species in *Trichothelium* follows Harris (1995).]

35a Spores 1-septate

36a Spores with a warted episporium; two cells of spore of equal size, uniseriate, with a thick septum; perithecia large (0.3-1.0 mm)

[*Acrocordia*]

[*A. conoidea* (Fr.) Körber, *A. macrospora* Mass., and *A. salweyi* (Leighton ex Nyl.) A. L. Sm. are species known from Europe and/or eastern N Am. Usually they occur on calcareous rock but *A. macrospora* occurs on siliceous or weakly calcareous rock. *Acrocordia gemmata* is reported from BC; *A. cavata* from coastal Oregon (Breuss in Rosentreter 2001, *Evansia* 18:131)

36b Spores smooth, without a warted or granular episporium, two cells of spore unequal. Thallus very thin, rimose cracked to almost farinose, medium to dark gray; perithecia < 0.1 mm wide; paraphyses gelatinizing; sp 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 µm (see additional description and notes in Noble 1982)

*Anisomeridium cf. carinthiacum* ((Stein.) R. C. Harris

(= *Arthophyrenia carinthiaca* J. Stein.)

33b On bark or wood

38a Perithecia orange to red brown, gray green, or dark pinkish gray; spores 16-23 x 3-5 µm, 3(-5) septate

*Porina*

(Includes *P. leptalea* (Durieu & Mont.) A. L. Sm. with orangish to red-brown perithecia, reported from BC by Aptroot (1996; *Bryol.* 99:196) and McCarthy & Tonsberg (1998) and *P. radicola* P. M. McCarthy & Tønsb. (*Lich.* 30:245-248.), with gray-green (thalline) perithecia, sometimes with a dark pinkish gray cap, from shady tree roots and lower trunks of *Alnus rubra* and conifers in

- hyperoceanic sites in BC and Washington)  
 38b Perithecia black; spores various in size, 1-3-septate  
 39a Spores typically 2-celled, but appearing 4-celled because of mid-lumina constrictions or wall thickenings; spores also constricted at the septum. Pseudoparaphyses ± 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; western N Am endemic, BC to Calif; seldom collected but probably common, at least in Oregon

***Arthopyrenia***

(*A. plumbaria* (Stizenb.) R. C. Harris and *A. cinereopruinosa* (Schaer.) A. Mass.)

(Most species of *Arthopyrenia* have been moved to various other genera.)

39b Spores otherwise

40a Spores 3-septate

- 41a Spores about 25-35 x 7-9 µm. Perithecia brown black, becoming large; not lichenized; on bark

***Massarina corticola*** (Fuckel) L. Holm

- 41b Spores 16-22 x 3-4(-5) µm. Thallus thin, shiny, smooth to somewhat granular, pale brownish gray to pale greenish gray; perithecia to 0.3 mm wide, the lower part of the involucrellum remaining as a black ring after the perithecium disintegrates; spores 3-septate, fusiform, hyaline, paraphyses simple, coherent, persistent; on hardwoods; distribution poorly known but apparently widespread

***Trichothelium aeneum*** (Wallr.) R. C. Harris

(= *Porina aenea* (Wallr.) Zahlbr., *Pseudosagedia aenea* (Wallr.) Haf. & Kalb)

(*Arthopyrenia cerasi* (Schrader) Mass. Is also 4-celled and would key here. It was reported from BC by Noble et al. 1987)

40b Spores 1-septate

- 42a 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*]**

[Very likely in the Pacific Northwest, *Acrocordia* includes both saxicolous and corticolous species. Several species are known from eastern N Am.]

- 42b Spores smooth, without a warted or granular epispore, Spores 10-18 x 4-7 µm; perithecial wall cellular, not containing bark cells; asci cylindrical to clavate, with a broad ocular chamber; perispore lacking; paraphysoids long-celled and slender; on hardwoods, less often on conifers; west of the Cascade crest.

***Anisomeridium biforme*** (Borrer) R. C. Harris

(= *Arthopyrenia biformis* (Borrer) Mass.)

## Key F: CRUSTOSE, APOTHECIA

1a Primary photobiont blue-green

2a Spores septate; apothecia lecideine

- 3a Spores 4-7 celled, elongate, 26-46 x 5-6 µm; apothecia red brown; thallus crustose to lobed rosetiform; thallus red-brown or olive, attached by rhizines; arctic alpine S to OP, rare

***Arctomia interfixa*** (Nyl.) Vain.

- 3b Spores 2-4 celled; apothecia black; thallus crustose, often with tiny marginal lobes; widespread, gen on calcareous rock

***Placynthium***

- 2b Spores non-septate; apothecia lecanorine; growth form variable  
4a Thallus blackish, gelatinous, nonstratified (homoiomorous), various in form

Key B, Page 3

- 4b Thallus olivaceous or brownish, stratified or not  
5a Thallus olivaceous, stratified (heteromorous), rosetiform with very narrow elongate lobes; photobiont *Scytonema*-like (filamentous, with intercalary heterocysts and ± paired false branches); on rock, often where moist or seepy; rare w Cas in Oregon and Washington, more common northward in BC and Alaska

***Vestergrenopsis***

- 5b 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

***Euopsis (granatina and pulvinata)***

(*Pyrenopsis* is similar but has perithecia-like apothecia, a tendency to moniliform paraphyses, and clavate rather than cylindrical asci.)

- 1b Primary photobiont green (cephalodia with blue-green photobionts may be present) or thallus not apparent

- 8a Apothecia lacking both proper and thalline margins

- 9a Spores muriform

***Arthothelium***

- 9b Spores simple to 1 or many septate

- 10a Spores thick-walled, often > 20 µm long

- 11a Disk black; thallus gray to white; very common, especially w Cas, mainly on bark, rarely on rock

***Mycoblastus***

- 11b Disk brown; thallus brown; abundant on bark w Cas, uncommon in RM

***Japewia***

- 10b Spores thin-walled, usually < 20 µm long, if thick walled then spores < 20 µm long

- 12a Cephalodia present; apothecia dark brown to black; on rock. Alaska and Yukon s to BC

***Pilophorus dovrensis* (Nyl.) Timdal**

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

- 12b Cephalodia absent; apothecia and substrate various

- 13a Asci free standing among the paraphyses, not imbedded in a hymenial gelatin; 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 gen 1-septate (occasionally more); apothecia stipitate or sessile

***Vezeada***

- 13b Asci imbedded in hymenial gelatin; thallus otherwise

- 14a Spores spherical, 5-7 µm wide, 16 per ascus; thallus thin; apothecia convex to hemispherical, dark brown; on soil, rotten wood, and detritus; Colorado; probably widespread but very inconspicuous

**[*Steinia geophana* (Nyl.) Stein]**

- 14b Spores not spherical

- 15a Spores septate with one cell enlarged; ascocarps orange brown, brown black, or black, often sessile; widespread, common, mostly on bark w Cas or *Populus* e Cas, but one species (*A. glebosa*) common on soil in steppe and alpine

***Arthonia***

- 15b Spores simple to septate and then with all cells of equal size; ascocarps pale yellow; bluish, gray to black or mottled; occasional, mainly w Cas

***Micareo***

- 8b Apothecia with thalline margin and/or proper margin

- 16a 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

**GROUP 1**

16b Apothecia with a proper margin only

**GROUP 2**

**KEY F, GROUP 1 (THALLINE MARGINED CRUSTOSE)**

1a Spores simple

2a Spores minute, gen < 5 µm long, many > 8/ascus; thallus brown, white, or fluorescent yellow-green; widespread, common, on rock and soil

*Acarospora*

2b Spores larger, gen > 5 µm long

3a Spores thick-walled (wall usually > 1 µm thick) at maturity, often very large

4a Cephalodia absent

5a Spores 1-8 per ascus, 1-celled, not fragmenting, medium-sized to large, generally thick walled; a large, common, genus that is widespread, on many substrates

*Pertusaria*

5b Spores 1 per ascus but fragmenting into two 1-celled spores. Medulla C+R, K-, KC+R, P-; spores huge (to 200 µm long), very thick walled; widespread but uncommon, so far known in our area from Idaho and Montana; on a wide array of substrates

*Varicellaria rhodocarpa* (Körb.) Th. Fr.

4b Cephalodia present; common on rocks and trees on the immediate coast

*Coccotrema* (see below)

3b Spores thin-walled (wall < 1 µm thick), small or large

6a Apothecia ± immersed or level with upper thallus surface

7a Apothecia *Pertusaria*-like, opening by a small pore; cephalodia present; on coastal trees and rocks; spores 45-65 x 23-39 µm, the spore wall 2-3.5 µm

*Coccotrema*

(One species, *C. maritimum* Brodo, occurs on seacoast rocks just above *Verrucaria maura*, so far known from coastal BC; the other species, *C. pocillarium* (Cummings) Brodo, is a white to yellowish gray sorediate crust on conifer and alder bark on the immediate coast from Alaska s to Oregon. The soredia are often pale orangish to pinkish.)

7b Apothecia with a ± expanded opening; cephalodia absent; substrate and habitat various; spores small or large

9a Apothecia brown, black, or greenish-black; epithecium HCl+ green or HCl-

10a Spores 30-45 x 16-30 µm; on detritus, mosses, and tree trunks; common, widespread

*Megaspora*

(= *Pachyospora*)

10b Spores smaller; substrate various

11a Apothecia black or greenish black; epithecium HCl+ green or HCl-

12a Epithecium deep bluegreen; asci with I+B apical dome; amyloid ring structure absent; spores 12-18 x 7-9 µm; hypothecium hyaline; thallus pale or darkening with the same pigment in the cortex as in the epithecium; see photo in Thomson (1997); apparently only one specimen is known from the PNW, alpine in GNP (McCune26188)

*Eiglera flavida* (Hepp) Haf.

12b Epithecium olive green, brownish green, or black green; asci with I- apical dome but with an I+B outer coat; a large common genus, mostly on rock and soil

*Aspicilia*

11b Apothecia some shade of brown, often reddish brown; epithecium HCl-

13a Medulla and ascus wall I+B; thallus areolate; fairly common on rock, mainly subalpine to alpine

**Bellemeria**

- 13b Medulla and ascus wall I-; thallus areolate, often developing into thick, warty protruberances ("isidia" in the literature); uncommon on rock by water at low elevations to alpine; spores 17-30 x 9-15  $\mu\text{m}$ , with a thick perispore when young; thallus gray; spot tests negative or medulla C+R, KC+R (gyrophoric acid); Alaska to Oregon, inland to east-central BC

**Koerberiella wimmeriana** (Körb.) B. Stein.

(Sometimes parasitized by *Sagediopsis aquatica* (B. Stein) Triebel)

- 9b Apothecium tan, yellowish, pale reddish, or pinkish; epithecium HCl-

15a Photobiont *Trentepohlia*

**Ionaspis odora** (Ach.) Th.Fr.

(*I. odora*, reported from BC, has spores 8-14 x 5-8  $\mu\text{m}$ ; thallus thin and scattered or cracked areolate, pale yellow-gray, pale reddish gray, or whitish yellow; hymenium 60-80  $\mu\text{m}$ ; upper hymenium and exciple K+ violet; occurs on damp siliceous rock; *I. epulotica* (Ach.) Arn., reported from coastal SE Alaska, has spores 13-22 x 5-12  $\mu\text{m}$ ; upper hymenium and exciple K-; occurs on damp calcareous rock or in calcareous seepage. Our subspecies is endolithic. *I. lavata* Magn., reported from Queen Charlotte Islands, is similar to *I. odora* but the former has a pinkish thallus in the field, becoming yellowish white in the herbarium, and deep brown disks, while *I. odora* has a light olive gray thallus, sometimes becoming ochraceous, with pink to pale brown disks)

- 15b Photobiont chlorococcoid. Spores 11-20 x 5-8  $\mu\text{m}$ ; thallus pale white, cream, to orange brown, pale orangish, or rusty red, smooth, continuous to lightly cracked, K-, I-; widespread (but apparently rare) arctic-alpine to temperate, semi-aquatic

**Ionaspis lacustris** (With.) Lutzoni

(= *Hymenelia lacustris* (With.) Poelt & Vêzda

(*Hymenelia* differs from *Ionaspis* only in the photobiont)

- 6b Apothecia adnate or bulging above thallus surface; widespread, common, on all substrates

18a Apothecia bright yellow

**Candelariella**

18b Apothecia white, tan, green, brown, to black but not bright yellow

- 19a Spores large, > 30  $\mu\text{m}$  long; thallus typically white to cream or pinkish; thallus and or apothecia often C+R; widespread, common, on many substrates

**Ochrolechia**

- 19b Spores small, < 30  $\mu\text{m}$  long; thallus color various; tissues C+ or C-

20a Exciple and hypothecium dark; thallus white; apothecia black, often with a white false-thalline margin; medulla I+B; thallus K-; uncommon on rock

**Porpidia speirea** (Ach.) Krempelh.

- 20b Exciple and hypothecium not both dark, or if so, apothecia and spot tests not as above

21a Thallus white, K+Y (atranorin); disk black

22a Hymenium violet to violet brown, epihymenium dark violet brown; spores 9-11 x 5.5-7  $\mu\text{m}$ ; containing atranorin and alpha-collatolic, bourgeanic, and alectoronic acids in various combinations; on both siliceous and calcareous rock (especially alpine) and on bark (especially w Cas), common

**Tephromela atra** (Huds.) Haf. in Kalb

- 22b Hymenium pale or hyaline, epihymenium various; very common, especially on bark and wood, but also on rock, soil, and moss

**Lecanora** (*subfusca* group)

- 21b Thallus white or another color, but if white then K- or disk not black

24a Thallus brown, reddish brown, dark gray brown, or olive brown

25a 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

26a Spores 12-18 x 4-5.5  $\mu\text{m}$ ; apothecial margin narrow, often darker than the disk; usnic acid present; apothecia sometimes pruinose, pale yellowish

brown to brown; Rocky Mountains, fairly common in subalpine to alpine, occasional in steppe

***Bryonora pruinosa*** (Th.Fr.) Holt.-Hartw.

26b Spores 15-25 x 5.5-7.5  $\mu\text{m}$ ; apothecial margin paler or concolorous with the disk; apothecia medium brown, 1-3 mm diam; thallus grayish white to red brown to dark gray brown, thin, granular or membranous; medulla K+Y-R (norstictic acid); rare in RM, subalpine to alpine

***Bryonora castanea*** (Hepp) Poelt

25b Thallus often fairly thick and  $\pm$  marginally lobate; on rock or parasitic on rock lichens; apothecia black, brown, or reddish brown; spores nonseptate

28a 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  $\mu\text{m}$ ; on siliceous rock, mainly arctic-alpine s to Colorado and OP; apparently uncommon

***Euopsis granatina*** (Somm.) Nyl.

(= *Pyrenopsis* g., *Lecanora* g.)

(*E. pulvinata* has *Gloeocapsa* only, with a crenulate red-brown exciple; *E. granatina* has *Gloeocapsa* and *Trebouxia* and an uneven whitish exciple containing *Trebouxia*. *Pyrenopsis tasmanica* Nyl. was reported from the Queen Charlotte Islands (Brodo 1995, Mycotaxon 56:162), contains *Gloeocapsa* only and has a red-brown granulose-areolate to almost peltate thallus and ascospores 8-10 x 4-5.5  $\mu\text{m}$  that are simple or appear partially septate.)

28b Thallus of larger areoles and lobes; apothecia usually larger

29a Marginal lobes slight or lacking; including many parasitic species, at least at first; thallus K+R (norstictic acid) or K-, often UV+ (lobaric acid); apothecia brown to black or olive black; fairly common on rock

***Protoparmelia***

29b Marginal lobes distinct; not parasitic; thallus K- (protolichesterinic acid), less often with pannarin (P+ orange) or psoromic acid (P+Y); apothecia orange-brown,  $\pm$  concolorous with the thallus; common, especially in dry areas e Cas (Columbia Plateau and Snake River Plain) south through Great Basin and Sierra Nevada

***Lecanora pseudomellea*** Ryan

24b Thallus another color, lobate or not

31a Thallus KC+R, C+R

32a Thallus without prominent marginal lobes; cephalodia lacking

33a Areoles growing on a bed of dark filamentous algae (*Stigonema*); apothecia with a thalline margin. Contains gyrophoric acid; spores 23-31 x 9-14  $\mu\text{m}$ ; coastal BC and Alaska; on siliceous rocks near the coast, usually exposed

***Placopsis roseonigra*** Brodo

33b Areoles not intimately associated with *Stigonema*; apothecia with a pseudothalline margin; common on rock w Cas

***Trapelia***

32b Thallus with prominent marginal lobes; cephalodia pinkish or brownish, conspicuous; apothecia with true thalline margin; common on rock w Cas

***Placopsis lambii*** (L.) Lindsay

(*Placopsis cribellans* (Nyl.) Räs. has been reported from sea level in Alaska and Coastal BC)

31b Thallus KC- or KC+Y; apothecia with a thalline margin

34a Disk C+ strong Y, densely white pruinose; growing on rock; thallus gen thick, whitish; on siliceous rock, widespread and common

*Lecanora rupicola* (L.) Zahlbr. and *L. bicincta* Ramond  
(= *Glaucosporium rupicola* (L.) Haf.)

(The thallus is often parasitized by the dark brown lichen *Rimularia insularis* and the disk is often blackened by the non-lichenized parasite *Celidium varians* Arn. (= *Arthonia glaucosporium* Nyl.) having 3-septate spores)

34b Disk C- or if C+ strong Y then growing on bark or wood

35a Epithymenium K-; substrate and spores various; apothecial margin generally clearly lecanorine; disk color various; widespread and common

*Lecanora*

35b Epithymenium K+ violet; on rock; spores oblong or narrowly ellipsoid, occasionally 1-septate; apothecial margin occasionally lecideine; disk black; Colorado

(*Apatoplasma oblongula* (Magn.) Poelt & Haf.)

1b Spores septate

39a Spores polarilocular

40a Spores hyaline; apothecia yellow, orange or red, K+ purple or red; widespread and common on many substrates

*Caloplaca*

40b Spores brown; apothecia dark-colored, K-

41a Thallus marginally lobate, yellow-green, brown, or gray; widespread and common, mainly in dry habitats

*Dimelaena*

41b Thallus not lobate

42a Spores with even, thin walls when young and at maturity; occasionally on bark, mainly w Cas

*Rinodinella*

42b Spores with unevenly thickened walls, at least when young, being thick walled at the apex, at the septum or both; widespread, common, on all substrates

*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*)

39b Spores thinly 1 septate or several septate to muriform

43a Spores with one to many transverse septa but no longitudinal septa

44a Spores 150-200 µm long, 1 per ascus, fragmenting into two 1-celled spores. Medulla C+R, K-, KC+R, P-; spores very thick walled; widespread but uncommon, so far known in our area from Idaho and Montana; on a wide array of substrates

*Varicellaria rhodocarpa* (Körb.) Th. Fr.

44b Spores < 100 µm long, not fragmenting

45a On rotten wood, mosses, or soil

46a On rotten wood or mosses

47a Thallus greenish; apothecia large, pinkish, often short stalked, the thalline margin prominent or disappearing; spores 1-3 septate, 15-25 x 4-6 µm; thallus P+O, K+O, KC+O, C-, UV+ white (thamnolic and perlatolic acids); common in moist forests

*Icmadophila ericetorum* (L.) Zahlbr.

47b Thallus whitish; apothecia minute (mostly 0.1-0.3 mm); thalline margin persistent; spores 1(3) septate, 11-21 x 4.5-7.5 µm; on bark and rotting wood and litter in subalpine; BC Cascades

*Anzina carneonivea* (Anzi) Scheid.

46b On soil

48a Thallus restricted to small triangular lobes surrounding the apothecia and formed from the exciple; disk brown to black; spores 1-septate, 10-15 x 4-5 µm; rare, dry areas in

Alberta and BC

*Solorinella astericus* Anzi

48b Thallus thin, membranous to granular, disk orange brown to paler and whitish; spores 3-septate, 12-24 x 5-9 µm; on soil; arctic alpine in RM

*Gyalecta foveolaris* (Ach.) Schaer.

45b On bark, wood, or rock

51a Apothecia bright red. Soredia lacking; thallus thick, yellowish, on siliceous rock; subalpine to mainly alpine, occasional

*Ophioparma lapponicum* (Räs.) Haf. & Rogers  
(= *Haematomma l.*)

51b Apothecia tan to brownish or pale grayish

52a On rock; spores 3-septate; thalline exciple lacking but the ± immersed, concave apothecia may give the superficial appearance of a thalline exciple; growing in damp shady places on siliceous rock; spores 12-16 x 5-7 µm; BC

*Gyalidea hyalinescens* (Nyl.) Vezda

52b On bark or wood; spore septation and habitat various

53a Paraphyses interwoven, netlike

54a Thallus prominently isidiate; asci thin walled; spores becoming 3-5 septate, 35-50(65) x 5.5-7.5 µm

*Loxosporopsis corallifera* (see below)

54b Thallus lacking isidia; asci very thick walled, bitunicate; spores 3-septate, 15-19 µm long. Thallus white, epiphloedal, 0.1-0.3 mm thick not containing calcium oxalate crystals; apothecia with well developed thalline margin; containing psoromic acid; one species in N Am, known from bark and wood, both conifers and hardwoods, coastal Cal n to Cape Blanco, Oregon

*Sigridia californica* (Tuck.) Tehler

53b Paraphyses parallel, simple or sparingly branched; asci thin walled or moderately thick walled, unitunicate

56a Apothecia minute (0.1-0.3 mm diam), ± sunken in the thallus; thallus whitish, thin; spores 1(3) septate, 11-21 x 4.5-7.5 µm; subalpine; BC Cas

*Anzina carneonivea* (Anzi) Scheid.

56b Apothecia larger or not immersed or both

57a Apothecia ± immersed to erumpent from the thallus, with a torn, irregular margin. Spores hyaline, (30)35-50(55) x 7-10 µm, with (7)9-11(12) transverse septa; apothecia 0.4-0.8 mm diam; spot tests negative; no lichen substances by TLC; on smooth-barked hardwoods in sheltered, damp sites; BC (Purvis et al. 1995, Bibl. Lich. 58:354) and coastal Oregon

*Thelotrema petractoides* P. M. Jørg. & Brodo

57b Apothecia otherwise

58a Paraphyses with dark swollen apical caps; 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 Wash and Oregon on *Alnus rubra* and *Salix*

*Halecania*

58b Paraphyses lacking dark apical caps; conidia sickle-shaped or curved filiform. Spores (0)1-3(7) septate; widespread but e Cas most common on *Populus* and *Salix* bark

*Lecania*

43b Spores muriform

63a On bark or wood

64a 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

65a Thallus sorediate; fully developed apothecia rare; on bark, mainly deciduous trees and shrubs; fairly common

*Phlyctis argena* (Ach.) Flot.

65b Thallus lacking soredia; apothecia common; usually on sheltered smooth bark of deciduous trees and shrubs, often on lower side of leaning stems; seldom collected; BC to Oregon, rarely inland to w Montana

*Phlyctis speirea* Merr.

64b Apothecia with a persistent prominent margin which arches over the disk; spores with a thick epispore 18-22  $\mu$ m wide; thallus K-; on bark and wood, w Cas

*Thelotrema lepadinum* (Ach.) Ach.

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

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

*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* (Batsch.) Zahlbr.

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

*Gyalidea*

(*G. lecideopsis* (Nyl.) Vezda and *G. hyalinescens* have been reported from Alaska and coastal BC; the former occurs on dry calcareous rock (and soil?) while the latter has 3-septate spores and occurs on damp siliceous rock)

**KEY F, GROUP 2 (PROPER MARGINED CRUSTOSE)**

1a Spores simple

2a Spores thick-walled, medium-sized (> 12 µm long) or very large (> 40 µm long)

3a Spores very large, > 40 µm long; apothecia black; thallus white to gray; very common, especially w Cas, mainly on bark, rarely on rock

*Mycoblastus*

3b Spores medium-sized, < 30 µm long; apothecia brown; thallus brownish; abundant on bark w Cas, uncommon in RM

*Japewia*

2b Spores thin-walled, < 40 µm long

4a Spores many more than 8 per ascus, minute (gen < 6 µm long)

5a On bark or wood; spores ± spherical

6a Exciple rudimentary, very thin to nearly absent; apothecia brown, black, or brightly colored

*Strangospora*

6b Exciple biatorine, poorly developed; apothecia pale yellowish or pinkish brown or whitish.

Infrequently collected; low elevation moist forests, especially on *Populus trichocarpa*

*Biatoridium delitescens* (Arn.) Haf.

5b On rock, soil, moss, detritus, or decayed wood; spores elliptical or spherical; thallus various

8a Thallus areolate, distinct, dark to pale brown or gray; on rock; arctic-alpine to subalpine, very common

*Sporastatia*

8b Thallus thin or obscure; substrate various

9a Apothecia and thallus citrine yellow; on gypsum rock or soil; not yet known in North America north of New Mexico

[*Biatorella clauzadeana* Llimona]

9b Apothecia and thallus not yellow

10a On soil, mosses, and decayed wood, apothecia pale brownish to light reddish brown; spores 6.5-8 x 2.5-3 µm

11a Apothecia with a narrow opening, perithecia-like; exciple often yellow granular pruinose (LM)

*Thelocarpon*

11b Apothecia with an expanded opening

12a 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* Anzi

12b 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;

*Sarcosagium campestre* (Fr.) Poetsch & Schiedem.

10b On rock; apothecia entirely black or dark brown with black margin; spores 3-6 x 1-2 µm, larger (7-10 µm long) in one species

13a Apothecia < 0.5 mm; exciple swollen and convoluted, ± obscuring disc; widespread, occasional

*Polysporina simplex* (Davies) Vezda

13b Apothecia ≥ 0.5 mm wide; exciple hardly raised, thin, not covering disc, often excluded; widespread, occasional

*Sarcogyne*

4b Spores < 16 per ascus, generally > 6 µm long

16a Spores dark, *Buellia*-like but non-septate or indistinctly 1-septate; arctic-alpine; thallus blackish, shiny, with areoles to 1 mm diam, angular or rounded, flat to convex; spores 12-18 x 6-10 µm; hypothecium dark brown; on siliceous rock; arctic south to Wash and New England

*Orphniospora moriopsis* (Mass.) Hawksw.

16b Spores hyaline or pale

17a Paraphyses free in water, simple; AND tholus gen I+ blue; common and widespread, on all substrates

*Lecidella*

17a Paraphyses coherent in water, simple or branched; OR tholus mostly I-, occasionally I+ blue, or tholus lacking

22a Exciple dark brown to black throughout or nearly so

23a On bark, wood, litter, or organic-rich soil

24a Thallus dark brown, granular, with sessile apothecia; 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)

24b Thallus pale gray to yellowish brown, areolate. Thallus K+Y, P+Y (alectorialic acid); spores small (gen < 12  $\mu\text{m}$  long); on bark or wood

*Hypocenomyce xanthococca* (Somm.) James & G. Schneid.

23b On rock or mossy rock, rarely on bark

25a Cephalodia present; spores often almond-shaped

*Amygdalaria*

25b Cephalodia absent; spores various

26a Apothecia gyrose; exciple dark brown,  $\pm$  carbonaceous; spores 8-11 x 5-8  $\mu\text{m}$

*Rimularia gyrizans* (Nyl.) Hertel & Rambold

(= *Lecidea gyrizans* Nyl.)

(These *Polysporina*-like apothecia are also seen in *Mosigia* (= *Rimularia*) *intercedens*, *Cecidonia* (*Lecidea*) *umbonella*, and other *Rimularia* species, but these are not known from the PNW. *R. limborina* with much larger spores (18-30 x 10-18  $\mu\text{m}$ ) has tentatively been identified from western Oregon: Breuss in Rosentreter 2001, *Evansia* 18:129.)

26b Apothecia not gyrose

27a Spores small (gen < 12  $\mu\text{m}$  long). Thallus K-, P- or P+R. Thallus some shade of brown, sometimes brownish-tinged white or gray, gen moderately thick to thick (mostly 0.3-2.0 mm); thalli typically clustered into a mosaic, the small individual thalli 1-3 cm diam and separated by marginal hypothalli; spores bean-shaped in some species (rarely 1-septate, occasionally turning brownish in old spores); Medulla mostly UV+, P- (divaricatic acid), less often UV-, P+R (fumarprotocetraric acid); hypothallus black to black-brown, apparent marginally; and sometimes between areoles; apothecia sessile or immersed; on rock, except for one species on bark

*Fuscidea*

27b 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

28a Thallus orange-brown, with blackening cracks and  $\pm$  immersed black apothecia; hypothecium brown; spores 9-16 x 5-9  $\mu\text{m}$ ; on siliceous (esp. iron-rich) rock; widespread but uncommon

*Tremolecia atrata* (Ach.) Hertel

28b Thallus otherwise

29a On various rocks in various habitats; exciple often dark but seldom carbonaceous; widespread, common

*Porpidia*

29b On calcareous rock or moss over rock, mostly subalpine and alpine; exciple dark, sometimes carbonaceous

30a On moss over rock; apothecia turbinate or substipitate; spores 10-17 x 3-4.5  $\mu\text{m}$ , 0(-1) septate; outer exciple greenish, dark purplish

- brown within; hypothecium dark purplish brown; true exciple well developed in young apothecia but becoming excluded; thallus granular, whitish to pale gray brown or ash gray; arctic-alpine; Alaska  
*Micarea crassipes* (Th. Fr.) Coppins  
 [*Micarea incrassata* Hedl. And *M. assimilata* area similar but they have an indistinct exciple and cephalodia are present.]
- 30b On calcareous rock  
 31a Thallus white, distinct; spores 18-27 x 9-14 µm; epithecium green to black green; medulla I+B  
*Farnoldia micropsis* (Mass.) Hertel  
 31b Thallus a trace of whitish or ochre white or absent  
 32a Spores 10-15 x 5-7 µm; hymenium 55-70 µm high; apothecia often sunken in rock; alpine; Colorado  
*Melanolecia transitoria* (Arn.) Hertel  
 32b 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* (Schaer.) Hertel
- 22b Exciple light colored or if dark then hyaline to brownish or blue-greenish internally; on all substrates  
 33a Apothecia orange, yellow orange, red, or reddish brown, in some species K+ purple; spores narrowly ellipsoid  
 34a On calcareous rock or alpine sod; apothecia orange; widespread, fairly common  
*Protoblastenia*  
 34b On bark and wood; apothecia orange-red to red, deep red, or brownish red  
 35a Spores < 14 µm long and < 8 µm wide, thin walled; epithecium K+R or K-  
 36a Epithecium K+R  
*Pyrrhospora*  
 36a Epithecium K-  
*Lecidea erythrophaea* Flörke  
 35b Spores 15-17 x 8-9 µm, thick walled; epithecium K- or brownish  
*Japewia carrollii* (Coppins & P. James) Tønsb.  
 33b Apothecia usually brown to blackish; spores commonly ellipsoid  
 37a Parasitic on *Lecanora rupicola* and *L. bicincta*; thallus dark brown, generally < 1 cm broad; very common e Cas, less common w Cas  
*Rimularia insularis* (Nyl.) Rambold & Hertel  
 37b Not parasitic on *Lecanora rupicola* group; thallus various  
 38a Thallus rust-brown, yellow-brown, dark brown or black  
 39a Hypothecium hyaline to pale brownish or grayish  
 40a Exciple black, carbonized; widespread but not often collected  
*Carbonea*  
 40b Exciple brown or hyaline, not carbonized  
 41a 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* (Schaer.) Hertel & Rambold  
 41b Medullary spot tests otherwise  
 42a Thallus C+R, KC+R  
 43a 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; paraphyses ± hyaline or pale throughout or with a brownish epithecium; 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. This distinction is weak at best. One common species of *Trapelia* on rock, *T. involuta* typically has a false thalline margin or thalline veil.)

43b Paraphyses simple or sparingly branched; spores mostly < 15 µm long; ascus *Lecidea* type; apothecia seldom with a thalloid veil

***Lecidea***

42b Thallus C-

44a 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* (see above)**

44b Exciple lacking algae

45a Exciple thin and reduced; asci *Bacidia* type. Paraphyses simple or sparingly branched, with a gelatinous coat that strongly expands in water, their tips with a dark hood; epithecium blue-green-black, continuous with the thin blue-green exciple edge; containing atranorin, usnic acid, and bourgeanic acid; arctic-alpine

***Tephromela aglaea* (Somm.) Hertel & Rambold**

45b Exciple usually well developed; asci *Lecidea* type. Paraphyses simple or sparingly branched, often with a dark tip; widespread, common

***Lecidea***

39b Hypothecium some shade of brown

50a Exciple brown, the edge dark brown; thallus bullate-areolate, brown to black brown, 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, 0.3-0.5 mm; arctic-alpine s to Colorado

***Rimularia impavida* (Th.Fr.) Rambold & Hertel**

50b Exciple hyaline to pale brown, the edge various; thallus various

51a Thallus yellow-brown, pale brown, or orange brown, thick, with a well developed black hypothallus; cortex K+R, C-, P±Y (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

***Tephromela armeniaca* (DC.) Hertel & Rambold**

51b Thallus brown, rust brown, or black-brown; thin or thick

52a Paraphyses and asci easily separating in K; asci without apical dome (tholus); uncommon

***Schaereria***

52b Paraphyses and asci coherent; asci often with apical dome; widespread and common

*Lecidea*

38b Thallus lacking or some shade of white, gray, olive-gray, or greenish

54a Hypothecium orange, brown, or darker

xa Spores mostly  $\geq 11 \mu\text{m}$  and  $\geq 3.5 \mu\text{m}$  wide

ya Spores 13-16 x 6-7  $\mu\text{m}$ ; tips of paraphyses slightly clavate, olive brown pigmented. On hardwood trees and shrubs, coastal BC s at least to Curry Co., Oregon; also in Macaronesia (Breuss 2001)

*Helocarpon lesdainii* (Zahlbr.) Breuss

(= *H. corticola* Breuss, = *Lecidea harmandii* Pitard)

[Reported from BC as *H. corticola* by Etayo (1998)]

yb Spores 10-13 x 4-5  $\mu\text{m}$ ; tips of paraphyses not widened, hyaline

*Lecidea albofuscescens* Nyl.

[Weakly pigmented or moribund forms of *Lecidella elaeochroma* may be confused with these. Although its apothecia are normally jet black, sometimes the disk will be light brown with a black rim. *Lecidella elaeochroma* has free paraphyses, broader spores (mostly  $> 7 \mu\text{m}$  wide), and an orange-brown to yellow brown hypothecium. Another "Lecidea" species with dark hypothecium and inner exciple and hyaline outer exciple has dark brown pigmented, slightly exposed tips of paraphyses, spores 10-11 x 4-5  $\mu\text{m}$ , hymenium K/I+ deep blue, exciple and hypothecium K/I-, asci completely K/I+ blue, and apothecial section POL-, K- (McCune 22029, Coast Range, Lane County, Oregon; on shrubs in old-growth forest).]

xb Spores mostly  $< 11 \mu\text{m}$  long and  $< 3.5 \mu\text{m}$  wide; epithecium green, green brown, black green, or blue green

55a Spores (5)8-11(12) x (1.5)2-3(4)  $\mu\text{m}$ ; 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 auriculata* Th. Fr.

55b Spores (6)7-9(10) x (2)3-4(5)  $\mu\text{m}$ ; epithecium dark blue green or green brown; thallus continuous on rock or grayish to inconspicuous on wood; inner exciple I-. Exciple persistent, thin,  $\pm$  raised; uncommon on rock and wood w Cas

*Micarea erratica* (Körber) Hertel

(= *Lecidea erratica* Körber)

54b Hypothecium hyaline or nearly so

56a Thallus K+Y->R, white to gray, dirty-gray, or light tan

57a On bark or wood; apothecia black, brown, tan, or mottled; spores 7-11 x 3-4  $\mu\text{m}$ ; thallus white to yellowish; occasional in moist forests

*Lecanora cadubriae* (Mass.) Hedl.

57b On rock; apothecia black

58a Thallus white to gray; widespread, fairly common in RM

*Lecidea lactea* Flörke ex Schaer.

(included in *L. lapicida* by some authors)

58b Thallus light brown or tan; occasional in RM

*Lecidea syncarpa* Zahlbr.

56b Thallus K+Y or K- or thallus lacking

60a Thallus grayish, dark blue gray, blackish, or blackish brown; apothecia immersed and often having a false thalline margin (appearing like an *Aspicilia*), black; areoles angular on a black hypothallus; hypothecium and inner exciple pale; epithecium blue green to violet; subalpine to alpine; rare or overlooked

*Schaereria fuscocinerea* (Nyl.) Clauz. & Roux  
(= *Schaereria tenebrosa* (Flot.) Hertel & Poelt)

60b Thallus otherwise or if dark colored then apothecia otherwise

61a Apothecia not completely black when moist (brown to purplish black); tholus amyloid (I+B); on calcareous rock

*Clauzadea*

61b Apothecia generally black or very dark brown, wet or dry; tholus mostly not amyloid; substrate various

62a Epihymenium K+ violet; spores simple or occasionally 1-septate, oblong or narrowly ellipsoidal; on sandstone; Colorado

(*Apatoplaca oblongula* (Magn.) Poelt & Haf.)

62b Epihymenium K- or K+ another color; spores simple, various in size and shape; substrate various

63a Exciple K+ blood red; hymenium light blue greenish; epithecium dark green to green black; exciple edge golden brown; apothecia to 1.8 mm; spores 6-11 x 3-4.5 µm

*Adelolecia pilati* (Hepp) Hertel & Haf.

63b Exciple not K+ blood red; common, widespread

64a 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. On rock (Brodo 1998, Lich. Thoms. 149-161) or bark (*F. lightfootii*, Aptroot 1996, Bryol. 99:196)

*Fuscidea*

64b Asci usually otherwise; apothecial pigments often greenish, bluish, or purplish in water, K, or N; paraphyses often branched and coherent

*Biatora* and *Lecidea*

1b Spores septate

70a Spores brown (or occasionally hyaline but then spores with halo and thallus saxicolous)

71a Thallus yellowish, parasitic on *Baeomyces* or *Diploschistes*; apothecia black; epithecium olive brown; exciple and hypothecium dark brown; spores 9-17 x 6-10 µm; thallus P+Y to O, UV+O (pulvinic acid derivatives); widespread, in both continental and oceanic climates

*Epilichen scabrosus* (Ach.) Clem. ex Haf.

71b Thallus otherwise

72a Spores 1 septate, submuriform, or muriform, usually with haloes; paraphyses branched and coherent; saxicolous; widespread, common

*Rhizocarpon*

72b Spores 1 septate or submuriform, without haloes; paraphyses ± simple; saxicolous or corticolous

73a Spores submuriform; widespread, common, especially on bark in moist forests

*Diplotomma*

73b Spores 1-septate or 3-septate

74a 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

*Hafellia fosteri* Imsh. & Sheard

74b Spores otherwise; habitat various

*Buellia*

70b Spores hyaline, lacking haloes; corticolous or saxicolous

75a 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* (Lahm) Th. Fr., the epithecium is K-)

75b Spores thinly 1 septate, multiseptate, or muriform (but not polarilocular)

76a Spores 1 septate (sometimes oil drops give a false impression of >1 septa)

77a Spores unequally 2-celled, one end broader than the other

78a Thallus parasitic in the hymenium of lichens

***Arthonia***

78a Thallus free living

79a Spores 10-15(17) x 3.5-7 µm. On conifer needles, small twigs, evergreen *Vaccinium* leaves, etc.; w Cas in Oregon and n Calif

***Fellhanera bouteillei*** (Desm.) Vězda

79b Spores 8-10.5 x 4-4.5 µm. On lignum

***Catillaria erysiboides*** (Nyl.) Th. Fr.

77b Spores equally 2-celled or nearly so

80a Apothecia white, beige, pale yellowish, or pale orangish, never blackening

81a Spores mostly < 4 µm wide

82a Photobiont *Trentepohlia*. Widespread, occasional in moist forests, on tree bases and mossy trunks, rarely on mossy rock

***Dimerella***

82b Photobiont chlorococcoid

***Absconditella***

81b Spores mostly > 4 µm wide

83a Disk minute (mostly < 0.25 mm diam), urceolate or concave, whitish, yellowish white, or red brownish

***Absconditella***

[*A. lignicola* Vezda & Pisut reported by Breuss in Rosentreter 2001, *Evansia* 18:129.]

83b Disk otherwise (often larger, plane to convex, or darker)

84a 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 µm; spot tests negative; thallus whitish, beige, pale gray green, or ochraceous; widespread

***Fellhanera***

(Two species known from PNW: *F. bouteillei* (Desm.) Vezda (= *Catillaria bouteillei* (Desm.) Zahlbr.), with 1-septate spores and *F. subtilis* with 3-septate spores)

84b 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***

80b Apothecia brown to black; or sometimes pale but blackening in part

xa Paraphyses branched and anastomosed; substrate siliceous rock, mosses, or detritus

ya On mosses or detritus; hypothecium reddish brown, at least in part; apothecia black, convex

***Micarea***

yb On siliceous rock; apothecia pale brown to blue black. QCI, BC (Brodo 1976) as

*Catillaria biformigera*

***Tylothallia biformigera*** (Leighton) P. James & Kilius  
(= *Catillaria biformigera* (Leighton) H. Magn.)

xb Paraphyses mostly unbranched; substrate various

85a Thallus of convex areoles or squamules; apothecia black; on slightly to distinctly calcareous soil, rock, or other lichens, especially gelatinous cyanolichens

***Toninia***

(incl. *Kiliasia* Haf.)

85b Thallus various, but seldom of consistently convex areoles; apothecia brown, purplish black, or black; substrate various

86a 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

*Catillaria* s.l.  
(incl. *Catinaria*)

(*Catinaria* (*atropurpurea* is type sp.) is segregated from *Catillaria* by: photobiont *Trentepohlia*, paraphyses with sharply delimited pigmented cap; spores halonate, pycnoconidia shortly bacilliform)

86b 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

*Megalaria*

76b Spores more than 1 septate (multiseptate or muriform)

90a Spores muriform

91a Apothecia with pseudothalline margins, urceolate; photobiont *Trentepohlia*; on rock

92a Hymenium and asci I+B

*Gyalecta*

(including *G. jenensis* (Batsch.) Zahlbr (Noble 1982) and *G. friesii* Körber (Bryol. 1996, 99:443)

92b Hymenium and asci I- or I+ orangish or red

*Gyalidea*

(*G. lecideopsis* (Nyl.) Vezda and *G. hyalinescens* have been reported from Alaska and coastal BC; the former occurs on dry calcareous rock (and soil?) while the latter has 3-septate spores and occurs on damp siliceous rock)

91b Apothecia with only proper margin

93a On mosses and plant remains, usually on acid substrates

94a Spores 1(-2)/ascus, 50-140 x 20-50 µm

95a Apothecia black or dark brown, short stalked or sessile. Arctic s to Alberta

*Lopadium* (*L. pezizoideum* and *L. coralloideum*)

95b Apothecia golden yellow or tinged olive black, short stalked or sessile; coastal Alaska, Aleutians to Juneau and Valdez, south to BC

*Brigantiaea fuscolutea* (Dicks.) R. Sant.

94b Spores 2-8/ascus, 20-40 µm long

*Schadonia*

93b On bark or wood; spores 1 or 8/ascus

97a Spores small, < 20 µm long. Spores 8/ascus, hyaline; apothecia reddish(-black), < 1 mm wide; usually on *Alnus rubra*, less often on conifers; BC and Wash

*Gyalideopsis piceicola* (Nyl.) Vezda & Poelt  
(= *Gyalideopsis alnicola* Noble & Vezda)

97b Spores large, > 65 µm long

98a Apothecia red. Spores (30)50-80 x 20-35 µm. Moist low-elevation conifer forests, inland BC s to Montana and Idaho, west to the Cas

*Brigantiaea praetermissa* Haf. & St. Clair

[Reports from the PNW of the Asian species *B. purpurata* (Zahlbr.) Haf. & Bellem. (= *Lopadium purpuratum* Zahlbr.) should be referred to *B. praetermissa*. The apothecia are similar in external appearance to *Pyrrhospora* spp, but the apothecia are ± flat and with a persistent margin.)

98b Apothecia black

xa Thallus superficial, distinct; on bark and wood; clearly lichenized with chlorococcoid algae. Spores 1/ascus, hyaline or pale brown; apothecia black, ±

short-stalked,  $\geq 1$  mm wide; tips of paraphyses dark brown; exciple brown throughout, darker at edge; fairly common in moist conifer forests, especially w Cas but also inland to w Montana

*Lopadium disciforme* (Flot.) Kullh.

xb 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 to 0.6 mm diam, dark brown to black, initially closed, becoming urceolate, the edge entire to dentate; true exciple black; hypothecium poorly developed, hyaline; so far known only from Scotland and Oregon

*Xerotrema megalospora* Sherw. & Coppins

90b Spores only cross-septate, without lengthwise divisions

99a Spores 3-celled; thallus subtly parasitic in the hymenium of *Lecidella*. Widespread from seacoast to alpine

*Arthonia intexta* Almq.

99b Spores otherwise, or if 3-celled then not parasitic on *Lecidella*.

100a Asci often thick walled; paraphyses interwoven, netlike anastomosing; apothecia mostly black or with light-colored pruina; photobiont *Trentepohlia* (lecideoid Arthoniales)

**Subgroup 2A**

100b Asci seldom thick walled; paraphyses anastomosing or not; apothecia black or not, pruinose or not; photobiont usually chlorococcoid (*Trentepohlia* in a few)

101a Spores fusiform (cigar- or banana-shaped), mostly  $< 5(9)$ -septate, then ends gen  $\pm$  blunt or broadly acute; mostly on organic substrates

**Subgroup 2B**

101b Spores long and narrow, often needle-like, straight or curled, often  $> 4$  septate with pointed ends; substrate various

**Subgroup 2C**

## Subgroup 2A

Cross-septate Lecideoid Arthoniales

105a Apothecia with a pseudothalline margin; hypothecium hyaline or pale brown

106a Thallus thin and sometimes endophloedal, containing calcium oxalate crystals; apothecia with poorly developed thalline margin; containing roccellic acid

*Schismatomma*

106b Thallus epiphloedal, not containing calcium oxalate crystals; apothecia with well developed thalline margin; containing psoromic acid; one species in N Am

*Sigridia californica* (Tuck.) Tehler

105b Apothecia lacking a pseudothalline margin, black, ± white pruinose; hypothecium hyaline or dark colored

107a Spores frequently and characteristically fragmenting. Apothecia black, round, irregular, or stellate; exciple dark, carbonaceous; mainly tropical, also eastern coastal Canada s to Florida; also in Monterey Co., Cal on *Cupressus*; one species known from the Cas

*Bactrospora* Mass.

107b Spores intact of occasionally fragmenting, not routinely broken

108a Spores 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; hypothecium hyaline; spores ovate to fusiform, often wider at one end, 11-17 x 3-4.5 µm, 3-septate; on bark or wood, conifers or hardwoods, ne N Am and Cal

*Cresponea chloroconia* (Tuck.) Egea & Torrente  
(= *Lecanactis chloroconia* Tuck.)

108b Spores thin walled, the locules rectangular; pycnidia in protruding warts; paraphyses irregularly branched, ± anastomosed; hypothecium dusky or dark

*Lecanactis*

## Subgroup 2B

Multiseptate fusiform-spored crusts with proper exciple

117a Spores mostly non-septate

*Biatora*

(Circumscription of *Biatora* is still unclear. The type species is *B. vernalis* (L.) Fr.)

117b Spores mostly septate

118a Spores 2-3 µm wide; apothecia black. Epithecium greenish black; spores 16-23 x 2.5 µm; thallus thin or disappearing; on bark or wood

*Bacidia circumspecta* (Norrl. & Nyl.) Malme

118b Spores > 3 µm wide; apothecia black or otherwise

119a 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

*Micareia*

(See *M. lignaria*, *M. leprosula*, *M. peliocaropa*, *M. ternaria*, and *M. turfosa*)

119b Proper exciple usually distinct, though often turned under when apothecia are strongly convex

120a Spores > 3-septate AND apothecia brown to black

xa Hypothecium dark

*Bacidia sabuletorum* m (Schreb.) Lett.

xb Hypothecium pale or hyaline

121a Spores 3-septate, 11-18 x 3-5 µm; epithecium brownish, purplish, or greenish; hypothecium pale; thallus greenish or gray green; On *Populus*

*Arthrosporium mpopulorum* Mass.

121b Spores 3-8 septate, 20-35 x 3-5 µm; epithecium pale to dark brown or blue green tinged;

hypothecium pale; thallus dark greenish to blackish, granular; on many kinds of bark and wood  
*Scoliciosporum chlorococcum* (see below)

120b Spores ≤ 3-septate OR apothecia brown to hyaline

122a On damp, shaded, rock or moss over rock

123a Spores 12-16(-24) x 5-7 μm, 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* (Nyl.) Vezda

123b Spores 15-22 x 3-4.5 μm, 3-septate; apothecia pale orange, broad; thallus thin, continuous to occasionally granulose; on rock or mossy rock in damp, shaded overhangs; BC (Bryol. 1996, 99:443)

*Gyalecta friesii* Körber

122b Habitat otherwise; spores various; thallus usually thicker, membranous or granular or subareolate

124a 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 μm, 1-3-septate; widespread, common in moist conifer forests

*Icmadophila ericetorum* (see above)

124b Apothecia and thallus not as above; substrate various

125a Exciple composed of loosely tangled hyphae, the surface sometimes tomentose.

Spores 3-septate, 12-18 x 3-5 μm; hypothecium dark brown; apothecia brownish to almost black, usually with a bluish tinge; exciple persistent and paler than the disk; n Cal to Queen Charlotte Islands BC; on *Alnus rubra* and *Picea sitchensis*

*Byssoloma*

(Three species of *Byssoloma* have been reported from the PNW (Brodo, Mycotaxon 56:146; Rosentreter 2001, *Evansia* 18:131), *B. marginata* (Arn.) Serus., syn. *Bacidia marginata*, does not have a tomentose exciple. Two other reported species are *B. leucoblepharum* (Nyl.) Vain. and *B. subdiscordans* (Nyl.) P. James (Aptroot 1996, Bryol. 99:196; Rosentreter 2001, *Evansia* 13:131). All of these species are keyed in the British flora.)

125b Exciple of radiating hyphae in a gelatinous matrix

126a Apothecia arising as an appressed cushion of tissue, remaining appressed or eventually ± constricted at the base

*Biatora*

126b Apothecia arising as a subspherical to spherical projection from the thallus, very soon constricted at the base to substipitate

*Mycobilimbia*

(See also *Waynea stoechadiana*: thallus squamulose, olive-green to brown green; spores 3-septate, 13-19 x 3-4 μm; soralia developing; Cal, rarely to BC; on trees)

## **Subgroup 2C**

Multiseptate needle-spored crusts with proper exciple

130a Paraphyses anastomosing; spores curled, curved, or sigmoid; exciple reduced. Apothecia light to dark brown or black; on bark, wood, rock, metal, etc.

*Scoliciosporum*

130b paraphyses not anastomosing; spores straight, sigmoid, or spiralled; exciple usually well developed (LM)

131a Hypophores present, black, forming a flange with lateral projections (see Fig. 15, p. 265 in Purvis et al. 1992); apothecia brown black to red brown, pale and translucent when wet, to 0.6 mm diam; spores 48-55 x 2-3 μm, 15-20-septate; on mossy trunks or rocks in damp microsites, including the supralittoral zone; reported from BC (Vancouver I) by Tønberg (1997)

*Gyalideopsis muscicola* P. James & Vezda

131b Hypophores lacking; apothecia various

132a On seacoast rocks

133a Spores 3-5 septate, 32-48 x 1.5-2 µm; thallus granulose isidiate

*Bacidia scopulicola* (Nyl.) A. L. Sm.

133b Spores 3-septate, 22-25 x 2.5-3 µm; thallus cracked areolate. Apothecia black

*Herteliana alaskensis* (Nyl.) Ekman

(= *Bacidia alaskensis* (Nyl.) Zahlbr.)

132b Substrate otherwise

135a Apothecia black or nearly so

136a Thallus yellow to yellowish green; on soil, mosses, and detritus; occasional in RM, mainly at high elevations

*Arthroraphis*

136b Thallus white to gray or greenish, on bark or rock

137a Thallus whitish or some shade of gray; spores often > 35 µm long, needle-like, straight to strongly spiraled; apothecia brown, tan, orange, or black; on bark, rock, or soil

*Bacidia*

137b Thallus usually dark green, gray, or gray green; spores < 35 µm long, banana shaped or ± straight; apothecia black to brownish; on bark or rock

*Scoliciosporum*

135b Apothecia brown, red, orange, pinkish, yellowish, or paler

138a 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*

138b Spores < 100 µm long; apothecia various but never deeply sunken in a rough-edged crater

139a Apothecia tan, orange, brown, or darkening

140a Spores 30-35(42) x 3-4.5 µm; paraphyses much branched and anastomosed; pycnidia filiform, to 65 µm long; on *Alnus rubra* at low elevations; Washington (Tønsberg 1997)

*Fellhaneropsis vezdae* (Coppins & P. James) Sérus. & Coppins

140b Spores various; paraphyses simple or nearly so. Widespread, fairly common, especially w Cas

*Bacidia* and *Bacidina*

139b Apothecia deep red, with distinct, paler margin; thallus pale yellowish or yellowish green; epithecium K+ intense blue then violet; uncommon in moist conifer forests; mainly on wood in canopies w Cas, shifting to tree bases in w Montana

*Ophioparma rubricosa* (Müll. Arg.) Ekman

(= *Bacidia herrei* Zahlbr.)

## Key G: CRUSTOSE, STERILE; ORANGE, YELLOW

1a Thallus K+ cinnamon brown, violet, violet blue, or purple-red; sorediate

2a Thallus K+ cinnamon brown or orange brown, dispersed to almost continuous, consisting of yolk yellow heaped or branched granules, which sometimes develop into deeply concave soralia up to 1 mm broad and concolorous with the thallus; lobes very short, rounded and lifting from the substrate; on soil, mosses, and acid rocks; uncommon in RM and intermountain valleys

*Lecanora reagens* Norm.

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 tominii* Sav.

- 4b Thallus esorediate, becoming lobed, often fertile; spores one-celled; widespread and fairly common on soil in exposed habitats in western and Arctic North America
- 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 Cas
- Caloplaca citrina** (Hoffm.) Th. Fr.
- (Reports of *C. chrysodeta* (Vain. ex Räs.) Dombr. (= *Leproplaca c.*) in the PNW are just highly sorediate morphs of *C. citrina*, according to Wetmore)
- (*C. xantholyta* (Nyl.) Jatta, not yet known from our area, is bright yellow with ± distinct marginal lobes, occurring on damp limestone cliffs)
- 6b Thallus K+ violet blue, areolate to completely leprose; apothecia fairly common, the margin sorediate; uncommon or rare, on deciduous trees; BC
- Caloplaca chlorina** (Flot.) Sandst.
- 5b Thallus corticate at least in part; substrate various
- 7a Thallus minutely foliose or fruticose; widespread, common
- Xanthoria**
- 7b Thallus crustose; widespread, common
- Caloplaca**
- 1b Thallus K- or K+Y
- 9a Thallus vibrant lemon-yellow to yellow-green
- 10a Thallus UV-
- xa Thallus P+O; soralia yellowish green
- Cliostomum flavidulum** (see below)
- xb 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; Europe, e N Am, and a few reports from the PNW; some reports may confuse this with *M. affinis*
- Mycoblastus alpinus** (Fr.) Kernst.
- 10b Thallus weakly to strongly longwave UV+ yellow, orange, or red brown
- 11a Thallus squamulose or areolate
- xa On sheltered rock, areoles soon producing soredia, often completely dissolving into soredia; apothecia uncommon, biatorine; disk pale yellowish or tan
- Psilolechia lucida** (see below)
- [Sterile *Arthroraphis 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.]
- xb On soil; areoles or squamules esorediate; apothecia frequent, lecanorine; disk brown. Usually fertile; spores minute, many per ascus; widespread, fairly common
- Acarospora schleicheri** (Ach.) Mass.
- 11b Thallus granular or completely leprose; spores > 4 x 2 µm
- 12b Thallus usually in small patches
- 13a On bark or wood; thallus granular
- Chaenotheca chrysocephala** (Turn. ex Ach.) Th. Fr.
- 13b On soil or moss over rock; thallus areolate or often dissolving into soredia; spores multiseptate, borne in black apothecia; occasional in RM, mainly at high elevations
- Arthroraphis**
- 12a Thallus usually extensive, completely leprose
- 14a Thallus bright yellow; containing calycin, vulpinic, or pinastric acids; rhizocarpic acid lacking
- 15a Containing vulpinic acid; producing tiny stalked mazaedia; widespread, common in some areas w Cas but distribution and abundance poorly known; Alaska to Oregon e to Great

Lakes and New England

*Chaenotheca chrysocephala* (Turn. ex Ach.) Th. Fr.

15b Containing calycin or pinastric acid or calycin + vulpinic acid; widespread and common

*Chrysothrix*

(*C. chlorina* (Ach.) Laundon is typically on rocks or conifers and contains calycin + vulpinic acid; *C. candelaris* (L.) Laundon is typically on trees, more rarely on rocks, and produces calycin or pinastric acid.)

14b Thallus vibrant yellow-green; containing rhizocarpic acid, ± vulpinic acid

16a Spores borne in a stalked mazaedium; containing rhizocarpic and vulpinic acids; spores non-septate, 2.5-5 µm; contains rhizocarpic and vulpinic acids; common and widespread on acid earth and tree roots in sheltered microsites

*Chaenotheca furfuracea* (L.) Tibell

(= *Coniocybe* f.)

16b Spores borne in an apothecium, 4-6 x 2-2.5 µm (sometimes indistinguishable by eye from *Chaenotheca furfuracea* when sterile); contains rhizocarpic acid; on sheltered rock and soil; northern, south at least to Oregon, Idaho, and Montana

*Psilolechia lucida* (Ach.) M. Choisy

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

17a On soil, plant detritus, or moss; widespread and common

*Candelariella*

17b On bark or wood (rarely rock)

18a Thallus granular isidiate to isidiate, pale yellow or greenish yellow

19a Propagules are gray green to yellow green coralloid granules; esorediate; on deciduous trees with nutrient-rich bark; uncommon w Cas

*Bacidia rubella* (Hoffm.) Mass.

19b Propagules are pale yellowish isidia on a continuous to rimose-cracked thallus; on bark or rock, coastal Alaska s to Wash Cas

*Pertusaria flavocorallina* Coppins & Muhr

18b Thallus otherwise

20a Thallus yellow to deep yellow, gen corticate at least in part; widespread, common

*Candelariella*

20b Thallus pale yellow to yellow green, soresidiate

21a 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; thought to be an old forest indicator in Scandinavia; BC to Oregon, inland to Idaho, also in e N Am

*Cliostomum leprosum* (Räs.) Holien & Tønseb.

21b Pycnidia lacking or inconspicuous

22a Thallus entirely soresidiate, C- or C+ orange

23a 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); on bark and wood; Cal to BC, mainly near the coast, often in exposed sites

*Pyrrhospora querneae* (Dicks.) Körb.

(= *Protoblastenia* q.)

23b Thallus yellow green to sulfur yellow (usnic acid), with a white cottony prothallus, K+Y, P+Y (also containing atranorin, porphyritic acid, and zeorin); not yet reported from our area; on rock, walls, and bark

(*Haematomma ochroleucum* (Neck.) Laundon var. *ochroleucum*)

22b Thallus thin and chinky or becoming entirely soresidiate, 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* Ach.

## Key H: CRUSTOSE, STERILE, CYANOLICHENS

1a Thallus with elongate fan-tipped lobes

See *Koerberia* and *Vestergrenopsis*, stratified cyanolichen key

1a Thallus squamulose or leprose, without elongate lobes

2a On bark; thallus of granular soredia, almost entirely sorediate but usually some subsquamulose lobes gen remaining; occasional w Cas, inland to w Montana where rare

*Pannaria mediterranea* Tavares

2b On soil, rock, and moss, less often on tree trunks; thallus often entirely sorediate; widespread, fairly common in areas of moist conifers forests, often on shady roadcuts

*Pannaria cyanolepra* Tuck.  
(= *Parmeliella c.*)

## Key I: LEPROSE CRUSTS, NOT YELLOW OR ORANGE

Green Photobionts

This section is largely based on data in Laundon 1992, Lich. 24:315-350; the British Flora; and Tønberg 1992, Sommerfeltia 14. The distribution and abundance of these species in N Am are poorly known; additional species are present in the PNW that are not represented in the following key.

1a Thallus with granules organized into weak to distinct marginal lobes

2a Thallus P+R or P+O

3a Lobation distinct; thallus yellowish white to pale yellowish green; not yet known from PNW despite numerous reports. Thallus powdery, forming irregular rosettes of granules to 0.5 mm diam; lobe margin flat or raised; lower side a continuous weft of hyphae forming a hypothallus that is whitish gray to brownish; soredia ca. 70 µm diam; thallus containing pannaric and roccellic acids, ± atranorin; on shaded acidic rock and mossy rock, occasionally on trees trunks

*[Lepruloma membranaceum* (Dickson) Vainio]

3b Lobation subtle; thallus color various

4a Thallus K+Y

5a Thallus containing atranorin and stictic acid

*Lepraria lobificans* (see below)

5b Thallus containing atranorin and either fumarprotocetraric or protocetraric acid

*Lepraria nivalis* (see below)

4b Thallus K-; containing pannaric acid or derivatives. Thallus of powdery-textured granules forming small irregular rosettes, with subtly lobed margins, whitish to pale yellowish to greenish gray with a white medulla; soredia ca. 40-100 µm diam; thallus P- or P+R or P+O, K-, C- (pannaric acid 6-methyl ester, ± pannaric acid, rarely with atranorin); on shaded rock and bark or over bryophytes on those surfaces, sometimes on soil

*Lepruloma vouauxii* (Hue) Laundon

(According to the British flora: "resembling a poorly developed morph of *L. membranaceum*... but that species is distinctly lobed, the medulla is inconspicuous, the hypothallus is well developed, and always contains pannaric and roccellic acids.")

2b Thallus P- or P+Y

6a Thallus P+ pale Y or P-; containing atranorin

*Lepraria borealis* (see below)

6b Thallus P+Y; containing alectorialic acid

*Lepraria frigida* (see below)

1b Thallus lacking marginal lobes

8a Thallus P+O or R

9a Thallus K+Y or K+R

10a Thamnolic acid present; thallus K+ deep Y, P+ deep O. Thallus granules to 0.1 mm diam; s and w Europe, not yet known from our area; on bare or mossy acid rocks where sheltered, damp, and humid, also on tree bases and shaded sandy soil

[*Lepraria umbricola* Tønsb.]

10b Thamnolic acid absent; thallus K+ weak or strong Y, P+O or R

11a Thallus containing oxypannaric acid; C+Y or C-, K- to K+Y or O, P+ brownish red

12a Thallus greenish white to pale greenish yellow, C+Y. Thallus a mass of powdery granules about 60 µm diam; this taxon requires TLC for confident identification

*Leproloma diffusum* Laundon var *diffusum*

12b Thallus greenish yellow or greenish orange, C-; (otherwise similar to the above taxon).

Thallus P+ instant orange, deepening to pinkish orange; reported from BC; fairly common in Oregon on sheltered mossy rocks and beneath overhangs

*Leproloma diffusum* Laundon var *chrysodetoides* Laundon

11b Thallus lacking oxypannaric acid; C-, K- or K+, P+O or P+R

13a Thallus yellowish green, P+Y to R (fumarprotocetraric acid + atranorin); apothecia occasional yellowish or often darkening with gray mottles to nearly black. Common on conifer trunks w Cas

*Cliostomum flavidulum* Haf. & Kalb.

13b Thallus whitish, grayish, or greenish gray

14a Thallus whitish to whitish gray, sometimes greenish or yellowish tinged; stictic acid lacking

15b Thallus KC+O, containing alectorialic and protocetraric acids; thallus whitish gray with a greenish to yellowish tinge; granules to 0.2 mm diam, often byssoid; on brick walls, mosses, rock crevices, and tree trunks. Pollution tolerant; temperate and montane; reported from BC

*Lepraria eburnea* Laundon

15a Thallus KC- or still Y, containing atranorin and either fumarprotocetraric or protocetraric acid; thallus whitish, almost lobate; granules to 0.5 mm diam; on rock (both calcareous and not), growing on bare rock or over mosses and lichens, and on soil in crevices. Widespread

*Lepraria nivalis* Laundon

14b Thallus greenish gray, containing stictic acid and atranorin, generally with constictic acid and zeorin). Granules to 0.4 mm diam; field identification is often possible by observing the greenish gray color and white medulla and P+ reaction; cosmopolitan; most common at low elevations; on shaded bark and calcareous rock, especially on mosses; tolerant of air pollution

*Lepraria lobificans* Nyl.

(= *L. finkii* (B. de Lesd.) R. C. Harris)

9b Thallus K-

16a Apothecia with soresiate margins often present; thallus P+R (fumarprotocetraric acid); on bark, wood, rock, rubber, etc. in cities and polluted areas

*Lecanora conizaeoides* Nyl. ex Crombie

16b Apothecia never found; thallus P+ orange or yellow or P- (fumarprotocetraric in various concentrations and fatty acids, often with atranorin); on moss cushions on acidic rock, rarely on soil, occasional on bark (especially *Betula*); exposed or in partial shade; temperate and montane

*Lepraria caesioalba* (B. de Lesd.) Laundon

(*L. caesioalba* is morphologically identical to *L. neglecta* but differing in chemistry and distribution; see also *Leproloma diffusum* above.)

8b Thallus P- or P+Y

18a Thallus K+Y

19a Thallus P+ pale Y or P-, KC- (atranorin)

20a Thallus pale yellowish or yellowish gray

*Cliostomum*

20b Thallus some shade of white, greenish, or grayish

21a Substrate usually tree trunks; granules to 0.1 mm diam. Thallus greenish, containing atranorin, rangiformic, and norrangiformic acids, ± roccellic acid; not yet reported from N Am

[*Leproloma jackii* Tønsb.]

21b Substrate usually mossy rocks, soil, or growing over other lichens; granules to 0.4 mm diam

22b Thallus not at all lobed, containing atranorin, often with porphyrillic and fatty acids, especially roccellic acid, rarely with psoromic acid; on mossy rock, soil, and other lichens, occasionally on acidic bark. Thallus gray or dark gray; both powdery and granular forms are known; Common in exposed alpine and subalpine sites; widespread

*Lepraria cacuminum* (Mass.) Lohtander  
(= *Leproloma cacuminum* (Mass.) Laundon)  
(= *L. angardianum* (Ovstedal) Laundon)

22b Thallus margin weakly lobed, containing atranorin, rangiformic, and norrangiformic acids, rarely with roccellic acid; on bare and mossy rocks. BC and Wash

*Lepraria borealis* Loht. and Tønsb.

19b Thallus P+Y, KC+ reddish orange (alectorialic acid)

23a On mosses, soil, rock, and other lichens in sunny sites; thallus margin not lobate; granules to 0.2 mm but not powdery in appearance. Thallus pale gray, rarely with accessory roccellic acid or atranorin; mostly on acid rock and stony soil, often directly on rock; widely misreported; distribution uncertain

*Lepraria neglecta* (Nyl.) Lett.

23b On mosses in damp limestone crevices; thallus margin sometimes obscurely lobate; granules to 0.6 mm, powdery to byssoid. Arctic alpine and boreal; Alaska and BC and Great Lakes area

*Lepraria frigida* Laundon

18b Thallus K-

25a Thallus UV+. Thallus dull greenish gray, usually bluish tinged, rarely brownish orange; granules to 0.1 mm diam; thallus with divaricatic acid and zeorin, P- or rarely P+O; on shaded bark or vertical acid rock, the rock bare or mossy; widespread

*Lepraria incana* (L.) Ach.

25b Thallus UV-. On rock and moss in limestone caves and crevices; thallus bluish green, changing to pale greenish gray in the herbarium. Hyphae forming a weft over the substrate; granules to 0.1 mm but often much smaller; lichen acids absent but one terpene present

*Lepraria lesdainii* (Hue) R. Harris

(According to Laundon (1992), this species "can usually be identified in the field without chemical studies. Its untinged verdigris-green thallus in limestone caves and crevices is unmistakable.")

*Lecanactis latebarum* (Ach.) Arnold form Europe has similar spot tests (UV+, lepraric acid ± roccellic acid) and forms spongy, felty cushions to 5 mm thick beneath rock overhangs. The thallus is whitish gray, often faintly tinged pink.

## Key J: 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 Cas

*Lecanactis megaspora* (Merr.) Brodo

[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 lignicolous or terricolous; 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; Wash
- Opegrapha soreidiifera* P. James
- 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). Very common on hardwood trees and shrubs w Cas
- Rinodina disjuncta* Sheard & Tønberg
- 5b Medulla UV-
- 6a 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 w Montana
- Japewia subaurifera* Muhr & Tønsb.
- 6b Soralia dark brown but abrading to green; soralia C+R, KC+R (gyrophoric, 5-O-methylhiasic and ± lecanoric acids); spores broadly ellipsoid to subglobose, 13-16 x 9-12 µm, with a gelatinous epispore; on *Alnus* and *Betula*; near the coast, Alaska to Cal, inland to Wells Gray, BC
- Schaereria corticola* Muhr & Tønsb.
- 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)
- 10a Thallus isidiate
- 11a Isidia (thallus granules) roundish
- 12a Thallus dark gray green, bluish gray, or gray brown
- 13a Thallus K+R. On old wood and mossy rock in dry climates
- Aspicilia mastrucata* (Ach.) Th. Fr.
- 13b Thallus K-. +Thallus of separate to heaped corticate granules, the granules bursting or eroding to produce greenish soredia; thallus P+ rust red (argopsin), KC+R (gyrophoric acid), K-, UV-
- Micarea leprosula* (Th. Fr.) Coppins & Fletcher
- 12b thallus yellowish; on wood and bark
- Ophioparma rubricosa* (see below)
- 11b Isidia cylindrical; thallus white to gray or yellowish
- 14a Isidia very fine (< 0.2 mm diam) and long (up to 2 mm long)
- Loxosporopsis corallifera* (see above)
- 14b Isidia mostly > 0.2 mm diam, short or long
- Pertusaria*
- 10b Thallus sorediate (or blastidiate)
- 17a Soralia elongate-linear or elliptical; thallus ± immersed within substrate
- 18a Thallus K- or K+Y, P- or P+ weak Y
- 19a Thallus K-, P-, C+R, KC+R (gyrophoric acid); soralia elliptical or round; apothecia and pycnidia unknown; BC and Washington (Tønberg 1997); "characterized by diffuse gray-brown stains with inconspicuous, punctiform to erose, fawn-colored C+ red (fleeting) soralia (Purvis et al. 1992); rare but locally abundant in humid coastal areas, mostly on *Alnus* but also on conifers and shrubs
- Opegrapha fumosa* Coppins & P. James
- 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, rarely collected but probably overlooked; western Montana (Evansia 28:128)

*Buellia arborea* Coppins & Tønsberg

18b Thallus K+Y or O, P+O, C-, KC- (stictic or norstictic acid)

20a Thallus containing atranorin, norstictic acid, and ± other substances in the stictic acid group; soralia pale cream gray to ash gray, but pale yellowish when abraded (when strongly yellowish pigmented then C+O, UV+O; the pigments are eumitrins and derivatives); apothecia rare; mainly on smooth bark surfaces of acidic barked hardwoods and conifers, less often on wood; Calif, Wash, and BC, apparently rare but possibly overlooked

*Buellia griseovirens*

20b Soredia often blue-gray or speckled; apothecia absent to numerous; TLC is often needed to separate this species from similar *Buellia* species; lignicolous; common w Cas

*Xylographa vitiligo* (Ach.) Laundon

17b Soralia ± roundish or thallus conspicuous

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

23a Soralia P+ rust red (argopsin)

[*Micarea leprosula* (see above)]

23b Soralia P-

24a Soralia cream or brownish, occasionally greenish; on detritus, mosses, and soil or rotten wood; widespread very common

*Trapeliopsis granulosa* (Hoffm.) Lumbsch

24b Soralia dark gray green; on hard wood or moderately rotted wood

*Trapeliopsis flexuosa* (Fr.) Coppins & James

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

25a Thallus KC+ instantly rose-violet, 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); very common w Cas, rare inland to w Montana

*Pertusaria amara* (Ach.) Nyl.

25b Thallus KC- or if KC+ orange, red, or violet then without bitter taste

26a Thallus K+Y or K+R

**Group 1**

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

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

**Group 2**

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 3**

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

**Group 4**

**Group 1**

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, KC- or still Y, P+Y, UV-; common on conifers and alders on the immediate coast; containing stictic and constictic acids

*Coccotrema pocillarium* (Cummings) Brodo

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 perlatic acids)

*Icmadophila ericetorum* (L.) Zahlbr.

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 (+ trace of norstictic, constictic, and related compounds); on deciduous trees and shrubs at low elev w Cas; so far reported from Washington

*Rinodina stictica* Sheard & Tønseb.

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); mainly on deciduous trees and shrubs; fairly common

*Phlyctis argena* (Spreng.) Flot.

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

6a Thallus K+ deep Y (thamnolic and elatinic acids); soralia forming powdery mounds or becoming confluent, very pale yellowish green, yellowish, or yellowish gray; cephalodia absent. Thallus thin and continuous or becoming warty, pale gray or whitish; spores 3-5 septate, 37-49 x 4-5 µm; reported from Snohomish Co, Wash by Brodo (Bibl. Lich. 58:28) and Oregon; on bark

*Loxospora elatina* (Ach.) Mass.

6b Thallus K+Y to O (stictic acid); soralia discrete; cephalodia normally present. On conifers on the coast

*Coccotrema pocillarium* (see above)

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 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 *Acer*, *Alnus*, and *Betula* at low elevations, often near the coast

*Mycoblastus fucatus*

10b Thallus whitish, of small corticate granules or areoles, often with discrete soralia; containing atranorin and fumarprotocetraric acid (K+Y)

*Pyrrhospora cinnabarina* (Somm.) Haf.

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

12a Thallus yellowish tinged (usnic acid present)

13a Thallus containing usnic acid and atranorin, ± trace of stictic acid; areoles flat, with punctiform yellowish soralia; on bark of shrubs, low elevations to (more often) subalpine; so far known from Alaska s to Wash

*Biatora flavopunctata* (Tønseb.) Hint. & Printzen

(*Lecanora flavopunctata* Tønseb.)

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

*Lecanora expallens* Ach.

12b Thallus not yellowish tinged from usnic acid

14a Thallus areolate to subsquamulose, the areoles incised, medulla K+Y and P+Y (alectorialic acid). Thallus grayish white, or pale yellowish brown; usually on acidic bark, rarely on wood; reported for BC by Tonsberg (1992)

*Hypocenomyce leucococca* R. Sant.

14b Thallus various but not incised-subsquamulose; alectorialic acid lacking

15a Soralia initially linear, marginal on the areoles, sometimes beneath the slightly raised edges of the areoles; soralia whitish; thallus light colored, gray white to gray green, containing atranorin and zeorin; on many hosts, including conifers and hardwoods, especially *Alnus*; NE US, SE Canada, Great Lakes, rarely in PNW (BC)

*Rinodina degeliana* Coppins

15b Soralia roundish or broadly confluent

16a Soralia punctiform, usually < 0.2 mm diam

*Rinodina griseosoralifera* Coppins

16b Soralia becoming larger

17a Thallus dissolving into soredia; containing zeorin and porphyritic acid; on bark or rock

*Haematomma ochroleucum* var. *porphyrium* (Pers.) Laundon

17b Thallus with yellowish sorediate patches

18a Soredia farinose, in flat to hemispherical mounds, usually discrete; apothecia to 0.8 mm diam, margins generally not sorediate. Thallus whitish to gray, thin, continuous to areolate or slightly warty; spores (7)10-14 x (4)6-8 µm; thallus containing 2-O-methylsulphrellin and atranorin and at least sometimes with usnic acid; spot tests negative or K+ weak Y; apothecia rare, disks pale greenish brown; BC to n Cal, oceanic (Tønsberg 1997)

*Lecanora jamesii* Laundon

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

18b Soredia granular, in excavate roundish patches coalescing into larger, continuous patches; apothecia rare, 0.5-1.0 mm diameter; margins becoming sorediate. Thallus thin to thick, with yellowish sorediate patches; thallus K+Y, KC-, P- or pale Y, C-, containing atranorin only; apparently widespread and fairly common; apothecia *allophana* type, rare, 0.5-1.0 mm diameter; margins becoming sorediate; spores 10-14(-16) x 5.5-8(-9.5) µm; widespread in more continental climates of N Am, fairly common in PNW

*Lecanora impudens* Degel.

(= *L. subfusca* var. *variolosa*)

(= *L. variolascens* auct.)

## Group 2

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 (lichexanthone), thin; north temperate to southern boreal, mostly eastern; on bark of deciduous or coniferous trees; containing gyrophoric and lecanoric acids

*Ochrolechia arborea* (Kreyer) Almb.

2b Thallus UV+ pale white or UV-

xa Soralia irregularly elongate, sometimes roundish but appearing in short rows; thallus thin, membranous

*Opegrapha fumosa* (see above)

xb Soralia roundish; thallus thin or thick

3a Thallus membranous, with discrete soralia; thallus C-, only soredia C+R; apothecia commonly present, pruinose to pruinose-scabrous, margins C-; contains variolaric acid; n RM from n BC to central Montana and Idaho; rare

*Ochrolechia gowardii* Brodo

3b Thallus usually thick, verrucose, C+R (even when thin); apothecia rare; margins C+R (cortex); lacking variolaric acid; UV- or pale white; widespread, common (also common on mosses)

*Ochrolechia androgyna* (Hoffm.) Arn.

1b Thallus gray, olive, greenish, or brownish

4a Thallus greenish, continuous, granular, subareolate, or of small coalescing areoles; soralia paler than the thallus

5a 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*; coastal BC to Oregon, occasional

*Trapelia corticola* Coppins & P. James

5b Soralia irregular or initially punctiform but coalescing, 0.2-1.6 mm diam

6a 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)

*Scoliciosporum sarothamni* (Vain.) Vezda

6b 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 North America; also containing gyrophoric acid,

*Trapeliopsis pseudogranulosa* Coppins & P. James

4b Thallus gray, olive brown, or brownish

7a Soralia dark grayish green to dark green, mostly on hard to moderately decayed wood; thallus of granular to flattened areoles; common, especially on wood and shingles w Cas, but seldom collected or noticed

*Trapeliopsis flexuosa* (Fr.) Coppins & James

7b Soralia cream or brownish yellow; on rotten wood and plant debris; thallus of granular to warty areoles

*Trapeliopsis granulosa* (Hoffm.) Lumbsch

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

### Group 3

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* (Hedl.) Räs.

(= *Lecidea efflorescens* (Hedl.) Erichsen)

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, finely granular, P+Y to R (fumarprotocetraric acid + atranorin); apothecia occasional yellowish or often darkening with gray mottles to nearly black. Common on conifer trunks w Cas

*Cliostomum flavidulum* Haf. & Kalb.

4b Thallus greenish or greenish gray, medium to coarsely granular. On bark and wood and many other substrates in cities and other polluted areas; apothecia with soredate margins are often present

*Lecanora conizaeoides* Nyl. ex Crombie

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; spores 17-20 x 9-11 µm; on acid bark (and rock?), often over deteriorating *Parmelia*; reported from BC on *Alnus* and *Betula*

*Rinodina efflorescens* Malme

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 soredate thalline margin; soralia dark green; on hardwoods and shrubs; near sea level in Wash and Ore

*Halecania viridescens* Coppins & James

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

6a Atranorin and chloroatranorin present, so normally K+Y

*Pyrrhospora cinnabarina* (Somm.) Haf.

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* Tønsb.

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

8a Thallus mostly immersed in the substrate in the non-sorediate parts; soralia concave to flat; thallus lacking succinprotocetraric acid

*Pertusaria pupillaris* (Nyl.) Th. Fr.

8b Thallus superficial to occasionally immersed in the substrate in the non-sorediate parts; soralia ± convex; trace of succinprotocetraric acid present. On conifers and hardwoods; northern, s to Oregon

*Pertusaria borealis* Erichs.

### Group 4

Thallus K-, KC- or KC+Y, C-, P-

1a Thallus of cream to yellowish corticate granules, not truly sorediate; on bare wood and bark

*Ophioparma rubricosa* (see above)

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

3a Thallus and medulla UV+ bluish white (perlatolic acid, sphaerophorin, or lobaric acid) or UV+ pink

4a Thallus UV+ pink (coronatol and unidentified xanthenes); pycnidia when present white pubescent.

Thallus thin, rimose and finely granular, often appearing felty, pale bluish green or tray green; prothallus white, forming a distinct border; soralia irregular, effuse, yellowish green; on bark of conifers, hardwoods, and rock; Olympic Peninsula (Tønsberg 1997)

*Bacidia viridifarinosa* Coppins & P. James

4b Thallus UV+ white or bluish white; pycnidia when present not white pubescent

5a Soralia of mixed yellowish and brown granules, occasionally yellowish green; thallus areolate to continuous; containing lobaric acid

*Japewia subaurifera*

5b Soralia greenish or yellowish green; thallus of convex areoles; containing perlatolic acid or sphaerophorin

6a Soredia powdery, about 20-30 µm in diameter, greenish or less often yellowish; soralia discrete or confluent; thallus grayish green, of small convex areoles, but the areoles not constricted at the base. Containing perlatolic and hyperperlatolic acids and related substances; areoles greenish, discrete or contiguous; apothecia rare; BC; on *Betula*, conifers, or other acidic-barked trees in damp sites

*Ropalospora viridis* (Tønsb.) Tønsb.  
(= *Fuscidea* v.)

6b 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, especially acidic-barked hardwoods such as *Alnus* and *Sorbus*; broadly distributed in oceanic western N Am, Alaska to California inland to western Montana; very common in western Oregon and Washington

*Rinodina disjuncta* Sheard & Tønsb.

3b Thallus and medulla UV- or UV+ pale yellowish

7a 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 present; on hardwoods, less often on conifers; low elevations w Cas, southwest BC to

western Oregon

*Rinodina thomsonii* Sheard

7b Blastidia absent

8a Soralia yellow to yellow green or vivid green (containing atranorin, planic acid, and usnic acid in soralia); thallus gray, thin to warty, often becoming consumed by the soralia; on plant detritus, wood, and acid rock; European and e N Am, cool forests to alpine; a few reports from the PNW

*Mycoblastus alpinus* (Fr.) Kernst.

8b Soralia yellowish, yellow brown, pale yellowish green, pale brown, or greenish; containing atranorin, secalonic acid A, thiomelin, and xanthonenes (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* in humid coastal areas; near Juneau, Alaska and in Norway

*Rinodina sheardii* Tønsb.

2b Soralia white to gray, pale greenish, or black, discrete

9a Thallus of thick greenish gray bullate areoles tipped with blackish soralia; apothecia rare; spores 2-celled, 22-28 x 12-15 µm; rare on bird perches of old wood, especially fenceposts; common e Cas, rarely w Cas, BC to Cal inland to Montana and Idaho

*Thelomma ocellatum* (Körb.) Tibell

9b Thallus thin, whitish to gray or greenish gray; soralia white to gray or blue-gray

xa Soralia UV+ (perlatolic acid). Thallus continuous to areolate or warty, gray to bluish gray; prothallus distinct, bluish gray to bluish black, visible at the edge of the thallus and/or between areoles; soralia discrete or somewhat fused, to 1.5 mm broad; on smooth bark of hardwoods, less often on conifers

*Mycoblastus caesius* (Coppins & P. James) Tønsb.

xb Soralia UV-

10a Soralia tiny (gen < 0.3 mm diam)

11a Soralia brownish or greenish, barrel-shaped, distinctly delimited by a white circular rim, to 0.3 (0.5) mm diam; apothecia rare, rust red; containing roccellic acid; subalpine to alpine on shrubs (*Alnus*, *Salix*, *Sorbus*); possibly common in that habitat

*Caloplaca sorocarpa* (Vain.) Zahlbr.

11b Soralia variously colored but not surrounded by a white rim

12a Atranorin present (though K-, acc to British Lichen Flora). Thallus also containing zeorin, P- or P+ pale Y; apothecia very rare; spores brown, 24-29 x 12-17 µm; thallus areolate, dull greenish white to pale gray or grayish brown, with blue-gray, mostly discrete soralia that are plane to ± convex; on eutrophic bark of hardwoods, often in cities; lowlands w Cas in Oregon and Washington

*Rinodina griseosoralifera* Coppins

12b Atranorin lacking

xa Thallus of scattered areoles, the areoles very thin, developing into thin soralia mostly 0.1-0.2 mm broad and occupying the whole areole. On shrubs (*Alnus*, *Salix*, *Paxistima*, *Vaccinium*); 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; low elevations to more often subalpine

*Biatora vacciniicola* (Tønsb.) Printzen  
(= *Lecidea vacciniicola* Tønsb.)

xb Thallus of contiguous to scattered areoles, the areoles becoming warty or irregularly verrucose and the warts bursting into soredia surrounded by cortex. Apothecia uncommon; spores hyaline, 10-13 x 6-8 µm; on deciduous trees, often at the base; w BC, WA, and Willamette Valley

*Caloplaca obscurella* (Lahm) Th. Fr.

(According to Tønsberg, this species is distinguished by its "crateriform soralia surrounded by a whitish or grayish lacerate sheet. The apothecial disk is brown. Due to the minute size of the soralia and apothecia, the species is easily overlooked in the

- field")
- 10b Soralia > 0.5 mm diam
- 13a Soralia irregular, forming a discontinuous leprose crust; thallus gen endophloedal; apothecia common, similar to *Lecidea turgidula*, black but bluish pruinose; containing pseudoplacodiolic acid; on dry bark, especially *Picea*, associated with Caliciales and *Chrysothrix*; so far known from coastal Alaska and inland BC (Wells Gray)
- Lecidea leprarioides* Tønsb.
- 13b Soralia round, medium to large (0.5-1.2 mm diam), developing in fruiting warts; thallus gen thin epiphloedal; apothecia common but obscured by the soredia; containing fatty acids only; spores 1-celled, very large (> 125 µm long); on bark and wood; abundant in conifer forests
- Pertusaria ophthalmiza* (Nyl.) Nyl.

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

- 1a Thallus isidiate or granular-isidiate, greenish or olive brown or dark brown
- 2a Thallus brown to dark brown
- 3a Photobiont cells 6-12 µm diam; lichenicolous on sunny exposed rocks. Thallus minutely isidioid or granular; apothecia usually few or absent, black, with dark thin exciple and dark hymenium; spores 12-16(20) x 6.5-9(10) µm; two chemotypes in British Flora
- Rimularia furvella* (Nyl. ex Mudd) Hertel & Rambold  
(= *Lecidea furvella* Nyl. ex Mudd)
- 3b Photobiont cells 5-9 µm diam; on shaded rock
- Placynthiella*
- 2b Thallus greenish or olive
- 5a Thallus with elongate very narrow lobes, forming olivaceous rosettes; photobiont blue green; on siliceous rock, in and w Cas
- Vestergrenopsis* and *Koerberia* -- see key to stratified cyanolichens
- 5b Thallus not lobate, greenish, granular isidiate; photobiont green; habitat shaded, maritime
- Bacidia scopulicola* (Nyl.) Sm.
- 1b Thallus sorediate or isidiate, but if isidiate then color otherwise
- 7a Thallus K+R (norstictic acid), white to gray; hypothallus dark gray to black, often distinct
- 8a Soredia coarse, granular; soralia often poorly delimited. On moss (esp. *Grimmia*) over rock, rock, and old wood, usually in dry sites e Cas
- Aspicilia mastrucata* (Ach.) Th. Fr.
- 8b Soredia powdery; soralia often neatly delimited
- 9a Thallus yellowish white to pale gray; soredia black or white to pale yellow
- cf. *Porpidia* sensu Gowan (1989)
- 9b Thallus gray or whitish gray; soralia dark gray; soralia roundish, discrete; medulla I+ violet or blue; Arctic s to at least the Canadian Rockies
- Bellemeria subsorediza* (Lynge) R. Sant.
- 7b Thallus K- or K+Y, color various; hypothallus various
- 10a Soredia or isidia dark gray; thallus white, gray, or brownish gray
- 11a Thallus lobate, forming small tightly appressed rosettes on sheltered siliceous rock; hypothallus indistinct or lacking. Thallus K-, C-, KC-, P-, UV-; widespread in semiarid climates; fairly frequent throughout the PNW but often inconspicuous and difficult to collect
- Caloplaca demissa* (Körber) Arup & Grube  
(= *Lecanora demissa*(Flotow) Zahlbr.)
- 11b Thallus not distinctly lobate; hypothallus black, often distinct
- 12a Thallus K+Y, KC+R, P+Y (alectorialic and barbatolic acids)
- Fuscidea praeruptorum* (Du Rietz & H. Magn.) Wirth & Vezda

- 12b Thallus K- or K+R, KC-, P- or P+R  
 13a Medulla I+ blue or black, K-; containing confluent acid; thallus moderately thick, medium gray, subareolate to areolate; prothallus usually present, often well developed; e N Am and Arctic  
[*Porpidia tuberculosa* (Sm.) P. James]
- 13b Medulla I-, K+Y (stictic acid); thallus dirty cream-gray to olive or brownish, subcontinuous to rimose or subareolate; soredia white, greenish white, or grayish; prothallus often visible; e Canada  
[*Porpidia soredizodes* (Lamy) Hertel]
- 10b Soredia white, yellowish, grayish, pale greenish gray, or lacking  
 15a Thallus isidiate, papillate, or with coarsely granular soredia  
 16a Thallus KC+R, cracked areolate, when sterile often with whitish spots which are immature apothecia  
*Trapelia coarctata* (Sm.) Choisy
- 16b Thallus KC-  
 17a Thallus cracked areolate, granular, scurfy-isidiate to granular sorediate, K-; mainly on supralittoral rocks  
*Aspicilia leproscens* (Sandst.) Havaas
- 17b Thallus entirely papillate, pinkish-gray; tentatively reported from BC by Noble  
*Lecania aipospila* (Wahl.) Th. Fr.
- 15b Thallus sorediate  
 18a Thallus with prominent pinkish to brown cephalodia; marginal lobes conspicuous; upper surface and medulla C+R, KC+R; abundant on rock w Cas  
*Placopsis lambii* (L.) Linds.
- 18b Thallus lacking cephalodia; margins not or slightly lobate  
 19a Thallus K+Y (atranorin, alectorialic, or stictic acid present), KC- or KC+ orange red  
 20a Thallus white to gray, cream, or brownish  
 21a Thallus mostly ecorticate and sorediate. Cortex K+Y, medulla K- (atranorin); Colorado  
*Haematomma ochroleucum* var. *porphyrium* (Pers.) Laundon
- 21b Thallus usually with extensive cortex  
 xa Thallus KC+O or R  
 ya Thallus P+ deep Y (alectorialic + barbatolic acids)  
*Fuscidea praeruptorum*
- yb Thallus P- or pale Y (gyrophoric acid). Soralia C+R, KC+R; thallus areolate, pale greenish gray; soralia greenish white, ± discrete, farinose, to about 0.5 mm wide; hypothallus black, often conspicuous; on exposed siliceous rock, so far known from near sea level in the San Juan Islands (Glew 1999; Evansia 16:168)  
*Rinodina aspera* (Borrer) Laundon
- xb Thallus KC-  
 22a Soralia in round patches, coarsely granular; apothecia, when present, of *allophana* type but small; rarely collected; Arizona, Wash, and Ontario  
*Lecanora umbrosa* Degel.
- 22b Soralia in discrete (or coalescing), convex soralia; thallus thick and uneven, white to gray. On siliceous rock, often beneath overhangs or in other sheltered microsities  
*Lecanora rupicola* var. *efflorens* Leuck. & Poelt  
 (= *L. rupicola* f. *sorediata*)
- 20b Thallus brownish orange to pale orange yellow, often with gray patches or margins. Cortex K- (or Y from diffusion), medulla K+Y (stictic acid); thallus continuous to finely cracked; medulla I-; soredia white or flecked gray, rarely darker; arctic-alpine s to Colorado  
*Porpidia ochrolemma* (Vain.) Brodo & R. Sant.

- (= *Hymenelia ochrolemma* (Vain.) Gowan & Ahti, *P. pseudomelinodes* A. J. Schwab)
- 19b Thallus K-, KC+ R or violet  
 27a Soredia white, KC+ violet (ephemeral), C-; usually on bark or wood, rarely on porous rock, including supralittoral rock
- Pertusaria amara* (Ach.) Nyl.
- 27b Soredia various, KC+R and/or C+R  
 28a Thallus whitish; fairly common (see above)
- Ochrolechia androgyna* (Hoffm.) Arn.  
*Trapeliopsis*, *Trapelia*
- 28b Thallus gray or darker; widespread and common, but most often on other substrates

## Key L: SQUAMULOSE

- 1a Squamules yellow, yellow-green, or orange  
 2a Squamules K+ purple  
 3a Lower surface corticate, occasionally rhizinate
- Xanthoria*
- 3b Lower surface ecorticate or too closely appressed to discern, lacking rhizines  
 4a Thallus pale to clear yellow; on calcareous soil; thallus squamulose, often marginally lobate; fairly common in cold or dry exposed sites
- Fulgensia*
- 4b Thallus yellow to orange; substrate various; thallus more often foliose to dwarf fruticose; widespread, common
- Caloplaca*
- 2b Squamules K-  
 5a Thallus yellowish green, LW UV-; apothecia sessile; disk brown; spores > 6 µm long, 8/ascus; occasional in steppe and desert
- Squamarina*
- 5b Thallus vibrant yellow to yellow green, LW UV+ (rhizocarpic acid)  
 6a Apothecia immersed; disks brown to almost black; spores minute (< 6 µm long), 1-celled, hyaline, many/ascus; widespread, common on rock and soil
- Acarospora*
- 6b 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, attached to cracks in rock and soil by crowded long black rhizines; lower surface black; arctic-alpine s to Colorado
- Catolechia wahlenbergii* (Ach.) Flot.
- 1b Squamules another color  
 7a Thallus greenish, ear-shaped with a raised lip at the margin, the interior gen sorediate; always sterile; cortex and medulla K-, P-, C-, KC-; often on moss or other lichens; common w Cas, rare (or overlooked) e Cas
- Normandina pulchella* (Borr.) Nyl.
- 7b Thallus variously shaped and colored but without a raised lip at the margin; often fertile; spot tests various  
 8a Ascocarps forming perithecia; usually fertile  
 9a Spores nonseptate, hyaline; hymenial algae absent; common, especially in cold or dry habitats, on rock, soil, or detritus
- Catapyrenium*
- 9b Spores septate, hyaline or brown; hymenial algae present or absent  
 10a Spores hyaline, 1-septate (ours); hymenial algae lacking
- Placidiopsis*
- (Two spp reported: *P. cervinula* and *P. pseudocinerea*; see Bryol. 99:445 and 97:365)
- 10b Spores muriform  
 13a Hymenial algae present; spores brown in almost all species; common on soil in steppe and desert, also on rock in mountains

**Endocarpon**

- 13b Hymenial algae absent; spores hyaline then light brown; thallus with gray-green to brownish squamules to 1 mm but gen much smaller and granular to coralloid; Colorado; on mosses or soil, especially over calcareous rock

**Agonimia tristicula** (Nyl.) Zahlbr.

- 8b Ascocarps forming apothecia or if sterile then often sorediate; thallus usually epruinose

14a Photobiont blue-green

- 15a Thallus umbilicate (peltate), with sorediate margins

- 16a Thallus 1-2 mm diam, thin (0.2-0.3 mm), dark olive green; Mexico to n Cal and N. Nevada

**[Peltula bolanderi** (Tuck.) Wetm.]

- 16b Thallus to 10 mm or more diam; 0.2-0.5 mm thick, tan to olive; uncommon with us; widespread, found throughout our area but more common to s into Cal

**Peltula euploca** (Ach.) Poelt

- 15b Thallus not umbilicate

- 17a Apothecia sunken in the thallus, the disk expanded and reddish

- 18a On soil; spores 15-24 x 6-10 µm, 8 per ascus; occasional in desert and steppe

**Heppia lutosa** (Ach.) Nyl.

- 18b On rock; spores < 10 µm long, > 16 per ascus; s Cal to ne Montana and s Sask

**[Peltula polyspora** (Tuck.) Wetm.]

- 17b Apothecia sessile; corticolous or saxicolous or on moss over rock, rarely on soil

- 19a Apothecia lecanorine; isidia absent or, if present, then not dense and fingerlike; widespread, common

**Pannaria**

- 19b Apothecia lecideine; isidia present or not

- 20a Thallus densely isidiate; apothecia often absent; rare or overlooked

**Parmeliella triptophylla** (Ach.) Müll. Arg.

- 20b Thallus of small squamules with incised margins; apothecia usually present; very common w Cas, rare inland

**Pannaria**

14b Photobiont green

- 22a Thallus sorediate or sterile; substrate various

- 23a Apothecia gen not borne directly on the squamules; squamules often with black, raised pycnidia and/or immature podetia. Substrate various; widespread, common

**Cladonia**

- 23b Apothecia, if present, on or between the squamules; squamules lacking pycnidia and/or immature podetia

- 24a Squamules lacking soredia or soredia marginal. Widespread, most common on charred wood but also on tree bases

**Hypocenomyce**

- 24b Squamules bursting open to form a soredia-lined pocket. 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; spores 3-septate, 13-19 x 3-4 µm; Cal to BC; on trees

**Waynea stoehadiana** (Abbassi Maaf & Roux) Roux & Clerc  
(= *Waynea californica* Moberg)

- 22b Thallus usually fertile, esorediate; on rock, moss, detritus, or soil

- 25a Asci polysporous; spores small, ≤ 5 µm long; cortex often KC+R; thallus gen brown OR whitish pruinose; widespread, common

**Acarospora**

- 25b Asci 8-spored; spores > 5 µm long; cortex KC+ or -; thallus color various

- 26a Apothecia with thalline margin, although the thalline margin may be lost with age

- 27a Saxicolous

- 28a Spores 1-3 septate  
*Lecania*
- 28b Spores nonseptate  
*Lecanora*
- 27b Terricolous or muscicolous
- 29a Apothecial margin lobulate, persistent; spores hyaline, simple; very common and widespread  
*Psoroma hypnorum* (Vahl) Gray
- 29b 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 in desert, steppe, and alpine  
*Phaeorrhiza*
- 26b Apothecia with proper margin or without a distinct margin
- 30a Spores simple
- 31a On bark or wood, commonly where charred  
*Hypocenomyce*
- 31b On soil, thin soil over rock, rock, or detritus
- 32a Thallus pale gray, creamy, or whitish above, C+R, KC+R; on soil and mosses over rock; uncommon in our area, common S of us (Cal)  
*Trapeliopsis wallrothii* (Flörke ex Spreng.) Hertel & G. Schneid
- 32b Thallus tan, brown, brownish green, or dirty gray above
- 33a Squamules grayish to brown-gray, on a thick fibrous black hypothallus; apothecia brown, deeply set to immersed in a gray to brownish thallus; epithecium K-; closely appressed to soil and detritus, very common and widespread, especially in subalpine to alpine  
*Lecidoma demissum* (Rutstr.) G. Schneid.
- 33b Squamules brick red to brown or greenish brown although sometimes completely white pruinose; hypothallus inconspicuous or absent; apothecia brown to black, sessile or immersed
- 34a Ascocarp irregular in shape, lacking proper and thalline exciples, eventually covering the entire squamule; ascocarp reddish brown; thallus olive brown; spores 13-17 x 7-9  $\mu\text{m}$ ; on gypsum soils, occurring with calciphiles; Alaska, BC, NWT, & Colorado  
*Gypsoplaca macrophylla* (Zahlbr.) Timdal
- 34b Ascocarp generally circular in outline, delimited with a proper exciple; ascocarp reddish brown, brown, or black
- 35a 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*
- 35b Epithecium greenish, K-; hypothecium dark brown, lacking calcium oxalate crystals
- 36a Squamules convex; spores subspherical, about (6)7-9(10)  $\mu\text{m}$  diam, uniseriate; paraphyses free; epithecium clear blue green, discoloring to brown; thallus warty-areolate to globose-squamulose or lobate squamulose, sometimes  $\pm$  stalked, gray to dark brown or red brown; apothecia black, sessile; on siliceous rock; arctic-alpine south to Colorado, New England, and Oregon  
*Schaereria cinereorufa* (Schaer.) Th. Fr.  
[See photo in Wirth, p. 849. The Oregon population is anomalous with smaller spores (5-5.5  $\mu\text{m}$ ), olive brown epithecium, and squamules partly with depressed centers.]

- 36a Squamules concave, with raised edge; spores elliptical  
 37a Thallus squamulose; apothecia never lecanorine.  
 Overgrowing *Spilonema* on rock; widespread but rarely collected.  
*Psorula rufonigra* (Tuck) G. Schneid.
- 37b Thallus ± crustose, of peltate areoles on a black hypothallus;  
 apothecia lecanorine when young  
*Lecanora scotopholis* (Tuck.) Timdal  
 (= *Lecidea s.*, *Psorula s.*)
- 30b Spores 1- or several septate  
 38a Spores dark, 1- to several-septate  
 39b Thallus brown. On rock or moss over rock  
*Buellia badia* (Fr.) Mass.
- 39b Thallus white. Occasional on soil in steppe  
*Buellia elegans* Poelt & *B. geophila* (Flörke ex Somm.) Lyngé
- 38b Spores hyaline; thallus various  
 41a Spores unequally 1-septate, hyaline; paraphyses coherent, interwoven; thallus brown; apothecia black; hypothecium brown; epithecium greenish black and brown; common on soil in dry or cold open habitats  
*Arthonia glebosa* Tuck.
- 41b Spores symmetrically septate, gen > 1-septate; thallus color various; apothecia dark or black  
 43a 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*
- 43b 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 and outer exciple K-; epithecium blue-green black or olive or mottled with both; common on soil and moss over rock, especially where calcareous, in forested mountains and steppe  
*Mycobilimbia lobulata* (Somm.) Haf.  
 (= *Toninia lobulata* (Somm.) Lyngé)

## Key M: UMBILICATE, FOLIOSE

- 1a Photobiont blue-green; thallus often ≤ 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 Cal  
*Peltula euploca* (Ach.) Poelt  
 (*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; isidia and soredia lacking  
 3a Perithecia present  
*Dermatocarpon*
- 3b Perithecia lacking  
 4a Habitat usually semi-aquatic (streamside rocks, trickle lines on cliffs, seepy cracks in outcrops, etc.)  
*Dermatocarpon*
- 4b Habitat various but seldom semi-aquatic  
*Umbilicaria*
- 2b Ascocarps forming apothecia; isidia or soredia occasionally present

5a 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* (Pers.) Müll. Arg.

5b Thallus and apothecia otherwise; spores larger, 8/ascus

6a Thallus yellowish to greenish, occasionally whitish; apothecia lecanorine; widespread and common, mainly e Cas

*Rhizoplaca*

6b Thallus brown to black, occasionally grayish or whitish; apothecia lecideine

7a Upper surface conspicuously blistered or warty, the warts typically 1-5 mm diameter and 1 mm or more high; rare disjuncts

*Lasallia*

7b Upper surface variously textured (often rugose) but not conspicuously warty; common

*Umbilicaria*

## Key N: STRATIFIED CYANOLICHENS

Foliose, 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* (L.) Ach.
- 1b Thallus without veins on the lower surface; lower cortex present or not  
3a Thallus minutely foliose or subfoliose; lobes  $\leq 2$  mm wide  
4a On bark or wood  
5a Spores slender and  $\pm$  twisted, ca.  $43 \times 1.5\text{-}2 \mu\text{m}$ ; Cal  
*Koerberia biformis* Mass.
- 5b Spores ellipsoidal to somewhat elongate, broader than  $5 \mu\text{m}$   
*Pannaria* and *Parmeliella*
- 4b On rock, mosses, or humus over rock  
6a Lower surface thickly covered with a dark hypothallus that become distinctly bluish black; upper surface gray, brown, or black; thallus monophyllous, 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, with a possible site in alpine of OP  
*Degelia plumbea* (Lightf.) Vain.
- 6b Lower surface otherwise  
7a On mosses or humus over rock or bark; thallus brown; lobes never longitudinally ridged  
8a Thallus brown or dark brown; lobes isidiate to lobulate; spores 2-4 celled. Spores  $11\text{-}27 \times 4.5\text{-}8.5 \mu\text{m}$ ; fairly common in a wide range of climates and substrates, from treetops in old-growth rainforest to mosses on soil in steppe  
*Massalongia carnosa* Körb.
- 8b Thallus gray or brownish gray; lobes isidiate becoming sorediose; spores simple  
*Pannaria praetermissa* Nyl.
- 7b On rock; thallus blackish, gray green, or olive colored; lobes often longitudinally ridged or striate  
9a Lower surface dark below, often with bluish rhizohyphae; thallus  $\pm$  black with blue rhizohyphae (under LM); spores 1-celled, about  $10 \mu\text{m}$  long; on moist siliceous rock; apparently uncommon; widespread, distribution poorly known  
*Spilonema revertens* Nyl.
- 9b Lower surface pale below, without bluish rhizohyphae; thallus green-gray; without blue rhizohyphae  
10a Thallus lacking isidia and lobules, usually fertile. Thallus forming rosettes 2 cm diam or more; lobes flat, appressed, often minutely grooved, about  $0.4\text{-}0.5$  mm broad; apothecia to 1 mm diam, with thalline margin; disk brown or dark brown; spores 12 or 16/ascus, 1-celled,  $8\text{-}10 \times 4\text{-}6 \mu\text{m}$ ; on damp rock; rare in coastal states and provinces, south to southern Washington Cascades  
*Vestergrenopsis elaeina* (Wahl. in Ach.) Gyeln.
- 10b Thallus isidiate or lobulate, rarely fertile  
11a Isidia very slender, cylindrical to  $\pm$  flattened, usually laminal in origin; lobes very thin, elongate, fan-tipped, and tightly appressed; apothecia margins thalline; spores 1-celled but sometimes falsely septate with plasma bridges,  $7\text{-}10 \times 4\text{-}6 \mu\text{m}$ , (8-)12-16/ascus; Alaska south to Oregon w Cas  
*Vestergrenopsis isidiata* (Degel.) E. Dahl
- 11b Isidia present or not, but with abundant narrow lobules, the lobules mostly flattened (some cylindrical) and arising from fine divisions of the lobe margins, often becoming

densely shingled on the upper surface; lobes thicker, shorter, and less tightly appressed than the preceding species, generally fan-tipped in part; apothecia margins variable, thalline or with a false proper margin; spores 1-2 celled, 10-30 x 1.5-4.5  $\mu\text{m}$ , 8/ascus; on siliceous rock; Cas inland to RM and s to Colorado and Arizona, occasional

***Koerberia sonomensis*** (Tuck.) Henssen

[*K. biformis* Mass. is a similar species on bark and wood in the southwestern US, but it has more elongate spores.]

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

12a Lower surface with white or yellow spots or pores (cyphellae or pseudocyphellae) < 2 mm diam

13a Lower surface with broad (generally 0.5-2 mm) whitish craters (cyphellae); almost entirely w Cas

***Sticta***

13b Lower surface with small (generally < 0.5 mm) white or yellow spots (pseudocyphellae or papillae)

14a 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. Common on bark and wood (rarely rock) w Cas, uncommon e Cas

***Pseudocyphellaria***

14b 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 Cas, occasional inland to w Montana

***Nephroma resupinatum*** (L.) Ach.

12b Lower surface lacking discrete white or yellow spots or pores, but in some spp with whitish patches > 2 mm diameter

15a 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. Very common on bark, wood, and rock w Cas, uncommon e Cas to w Montana

***Lobaria***

15b 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)

16a Soredia lacking; lobules sometimes present

17a Lobules present

18a Lobules containing green algae, thallus otherwise with a blue-green photobiont; apothecia unknown in this morphotype. Thallus to 2 cm diam; rare on conifer branches in old-growth forests w Cas, BC to Oregon

***Lobaria oregana*** (Tuck.) Müll. Arg. (blue-green photomorph)

(= *Nephroma silvae-veteris* Goward & Gof.)

18b Lobules and thallus similar in color and both containing a blue-green photobiont; apothecia if present on the lower surface of the lobe tips

***Nephroma***

17a Lobules absent

19a Apothecia on lower surface of lobe tips; thallus brown to gray brown; on bark and wood. Widespread, common w Cas, most spp uncommon e Cas

***Nephroma***

19b Apothecia on sunken in the upper surface of the lobes; thallus brown, grayish, or greenish; on soil and moss, especially in calcareous areas, mostly subalpine and alpine

***Solorina***

16b Soredia present

20a Soredia mainly laminal; lower surface smooth and bare or faintly pubescent

21a Upper surface yellowish tinged when dry, bluish gray when moist; lower surface smooth and bare. Thallus to 15 cm diam; rare on branches of conifers in old-growth forests w Cas, BC to Oregon

***Nephroma occultum*** Wetm.

21b Upper surface brown or grayish brown, not tinged with yellow; lower surface bare or

finely tomentose

20a Soredia mainly marginal; lower surface tomentose

22a 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* (Ach.) Schrad.

22b Upper surface with matted or erect tomentum; veins lacking; rare coastal species

23a Upper surface with stiff prominent hairs; with lichen substances (P+O, eriodermin); upper cortex with ± irregular thick-walled cells. Thallus grayish brown; lobes to 5 mm wide; upper surface erect tomentose; lower surface white or pale cream with small dense tufts of dark marginal rhizines; superficially similar to *Leioderma solediatum*; rare, epiphytic near the coast

*Erioderma solediatum* D. J. Gall. & P. M. Jørg.

23b Upper surface arachnoid tomentose, never with stiff hairs; usually without lichen substances (P-); upper cortex paraplectenchymatous, with regular, thin-walled cells; rare on bark and wood near the coast, especially on ericaceous shrubs in *Pinus contorta* dunes

*Leioderma solediatum* D. J. Gall. & P. M. Jørg.

## Key O: 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*

2b Thallus K-

3a Lobes gen < 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 concolor* (Dicks.) B. Stein

3b Lobes gen > 2 mm wide

*Vulpicida*

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

6a Lobes hollow, partially hollow, or solid but distinctly appearing inflated

7a Lobes solid but swollen and appearing inflated; generally on rock, occasionally on moss over rock; medulla P-. Subalpine to alpine, fairly common

*Brodoa oroarctica* (Krog) Goward

(uncommon forms of *Hypogymnia imshaugii* with solid lobes will key here)

7b Lobes hollow; substrate and spot tests various

8a Upper surface perforate; thallus closely flattened to the substrate; frequent w Cas, especially on *Alnus*

*Menegazzia terebrata* (Hoffm.) Mass.

8b Upper surface not perforate, but lobe tips often perforate; thallus appressed or loosely attached to the substrate

*Hypogymnia*

6b Lobes neither hollow nor appearing inflated

10a Lower surface with distinct or diffuse veins; cephalodia often present as superficial grayish warts on the upper surface

*Peltigera*

10b Lower surface not veined, though often variously textured (smooth, wrinkled, warty, etc.)

11a Lower surface mottled with pale to brownish tomentum and irregular bare patches; thallus usually large

*Lobaria*

11b Lower surface variously patterned or smooth but not mottled as above; thallus size various

12a Thallus yellow-green to greenish (containing usnic acid) when dry, but often darkening in exposed habitats, medium to small; lobes medium to narrow

**Group 1**

12b Thallus white, gray, greenish gray, brown, or blackish (usnic acid lacking or not apparent)

13a 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)

14a 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 2**

14b Upper cortex K- or cortex too dark to see the K reaction; upper and lower surfaces various

**Group 3**

13b Lobes generally broader, generally  $\geq 1.5$  mm wide; thallus medium to large, often > 3 cm

**Group 4**

## Group 1

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; northern, mostly out of our area

*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* (Schaerer) Hale

3b On bark and wood

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

*Evernia prunastri* (L.) Ach.

5b Lobes ± 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-; common w Cas, especially on *Alnus*, shrubs, and other deciduous spp

*Hypotrachyna sinuosa* (Sm.) Hale

7b Lobes medium, > 2 mm broad; lower surface brown; rhizines generally simple, sparse; medulla C+R, KC+R; substrate various, mainly e Cont Div

*Flavopunctelia soledica* (Nyl.) Hale

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 Cas

*Parmeliopsis ambigua* (Wulf.) Nyl.

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 south of PNW

*Flavoparmelia caperata* (L.) Hale

### 1b Soredia lacking

9a On bark or wood

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

*Cetraria pallidula* Tuck. ex Riddle

(= *Ahtiana pallidula* (Tuck. ex Riddle) Goward & Thell)

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

*Ahtiana sphaerosporella* (Müll. Arg.) Goward

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* (L.) Ach. and *C. cucullata* (Bell.) Ach.

## Group 2

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

1a On soil in semiarid sites; apothecial margin lecideine; thallus closely appressed to calcareous soil, upper surface K+ dirty Y; uncommon e Cas

*Buellia elegans* Poelt

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* (Ach.) S. F. Meyer

2b Isidia lacking; thallus and substrate various

3a Lower surface densely pock-marked with tiny pits (use lens); mainly w Cas

*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 gen present; medulla K+Y to R (salazinic acid and zeorin); coastal BC to Cal, coastal, uncommon to rare in our area

*Heterodermia*

[*Heterodermia leucomelos* (L.) Poelt is the commonest species in our area. An essentially identical species but K+Y in the medulla (lacking salazinic acid) is *H. boryi* (Fee) Hale. It is widespread in tropical and subtropical latitudes and has been found in San Luis Obispo County, Cal *H. erinacea* (Ach.) W. Weber is similar but lacks soredia and has a medulla K+Y (unknown substance plus zeorin in medulla); it occurs in the coastal fog zone and is rare from San Francisco to San Diego. *H. namaquana* Brusse has lower surface ecorticate and sorediate throughout while *H. leucomelos* has soredia mainly toward the lobe tips and the ecorticate lower surface is clearly bordered by the reflexed upper cortex; see Esslinger and Bratt (1998) for more details.)

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* (Ach.) Arn.

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); s RM, n to e Montana

[*Imshaugia placorodia* (Ach.) S. F. Meyer]

8b Disk dark brown to black (or white pruinose); spores brown, septate; medulla P- or P+ pale Y

*Physcia*

## Group 3

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

*Cetraria hepatizon* (Ach.) Vain. and *C. commixta* (Nyl.) Th. Fr.

- 2b Pycnidia immersed, mainly laminal if present; pseudocyphellae, if present, laminal; lobes and habitat various
- 3a Lower surface lacking rhizines; lobes narrow and thick, often nodulose; pseudocyphellae lacking; mostly alpine
- Allantoparmelia*
- 3b Lower surface rhizinate; lobes thin to moderately thick; pseudocyphellae present or not; widespread
- 4a Upper surface a rich brown to almost black, lacking angular markings or angular markings very subtle
- 5a Cortex N+ dark blue-green; thallus with globular isidia that often become sorediose; pseudocyphellae lacking. Widespread, common
- Neofuscelia*
- 5b Cortex N-; isidia present or not; pseudocyphellae present or not
- Melanelia*
- 4b 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.)
- 1b Thallus another color OR on another substrate
- 7a Lower surface white to pale brown
- 8a Soredia lacking
- 9a Thallus with few or no marginal rhizines. Lobe tips gen with pale glassy cortical hairs; algal layer discontinuous giving the upper surface a dark-spotted appearance; uncommon e Cas on calcareous rock and moss over rock
- Anaptychia ulotrichodes* (Vain.) Vain.
- 9b Thallus with abundant long, pale marginal rhizines or cilia; on bark or rock
- 10a 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 setifera* Räs.
- 10b 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 Cas, most often in crevices in calcareous rock, subalpine to alpine
- Phaeophyscia constipata* (Norrl. & Nyl.) Moberg
- 8b Soredia present
- 11a 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 Cas
- Phaeophyscia nigricans* (Flörke) Moberg
- 11b Lobes broader (mostly > 0.3 mm), with discrete laminal, marginal, or terminal soralia; mainly on *Populus* trunks e Cas
- 12a Lobe tips lacking pale cortical hairs; lower surface always pale below; lower cortex prosoplectenchymatous;
- Physciella*
- 12b 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* (Mereschk.) Essl.
- 7b Lower surface brown to black or thallus too closely appressed to tell
- 14a Lobes suberect or erect
- Cetraria*
- 14b Lobes ± appressed
- 15a Thallus firmly adnate to the substrate
- 16a On rock; lower cortex and rhizines lacking but similar in appearance to a minute *Phaeophyscia*, but actually crustose
- Caloplaca demissa* (see above)
- 16b On bark; lower cortex and rhizines almost lacking; pycnoconidia filiform, gen > 15 µm long
- 17a Soredia lacking; Colorado
- [Hyperphyscia syncolla* (Nyl.) K. Kalb]

17b Soredia present; Great Plains and Cal, at least as far n as Humboldt Co.

[*Hyperphyscia adglutinata* (Flörke) Mayr. & Poelt]

15b Thallus adnate to loose on the substrate but generally easy to separate from it; pycnoconidia otherwise; substrate various

18a 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*

18b 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 4

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  $\pm$  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* (Hook.) Kärnef.

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

*Neofuscelia*

4b Cortex N-; isidia present or not; pseudocyphellae present or not; substrate various

5a Lower surface lacking rhizines; lobes narrow and  $\pm$  thick; on rock; pseudocyphellae lacking; mostly alpine

*Allantoparmelia*

5b Lower surface with rhizines; lobes and substrate various; pseudocyphellae present or not; habitat various

*Melanelia*

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  $\pm$  free from substrate; rhizines absent to moderately abundant

8a Upper surface with pseudocyphellae OR lobe margins with black cilia; primarily w Cas

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 Cas

*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 Cas

*Pseudocyphellaria rainierensis* Imsh.

11b Pseudocyphellae on both upper and lower surfaces, small,  $\pm$  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 ( $\pm$  perlatolic and imbricatic acids); cortex K+Y (atranorin);

w Cas, uncommon, mainly on riparian *Alnus*

*Cetrelia cetrarioides* (Del. ex Duby) Culb. & Culb.

10b On rock, moss, and humus; upper surface yellowish tinged (usnic acid), mottled or edged with black; medulla K-, C-, KC+ pink (alecoronic ± 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 isidiate, whitish to tan, black mottled, or mainly black; containing atranorin, alecoronic, and alpha-collatolic acids (medulla KC+ pink); arctic-alpine s to n BC

*Asahinea scholanderi* (Llano) Culb. & Culb.

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 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 Cas, less often in drier forests and treetops w Cas

*Esslingeriana idahoensis* (Essl.) Hale & M. J. Lai  
(= *Cetraria i.*)

14b 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 Cas, 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)

19a On rock; upper surface brownish; coastal, BC to Cal

*Punctelia stictica* (Del.) Krog

19b On bark or wood; upper surface pale greenish gray; Cal

(*Punctelia borreri* (Sm.) Krog)

16b Upper surface lacking pseudocyphellae

21a Soredia and isidia lacking; margins sparsely to moderately ciliate; mainly on deciduous trees, common in Cal, rare northward, sporadic records known from southwest Oregon

*Parmelina quercina* (Willd.) Hale

21b Soredia or isidia present

22a Soredia lacking, isidia present, the isidia becoming ciliate; medulla K+Y, C-, P+O (stictic acid); n Cal to BC, mainly near the coast, fairly common

*Parmotrema crinitum* (Ach.) M. Choisy

22b Soredia present, isidia lacking; lobes with marginal cilia or cilia lacking

23a Lobes typically > 3 mm wide; soredia gen powdery; lobe margins usually conspicuously ciliate; medulla K+Y or K+O and UV-(stictic or salazinic acid) or K- and KC+R (alecoronic if UV+ or lecanoric acid if UV-); common on bark, occasionally on rock, w Cas, 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 sores; on rock and soil; Colorado

[*Parmelinopsis swinscowii* (Hale) Elix & Hale]

24b Lobe margins lacking cilia, rhizines sparsely or densely dichotomously branched

*Hypotrachyna*

(Only 2 gray species of *Hypotrachyna* in the PNW: *H. revoluta* (Flörke) Hale has lobes irregularly bent across the long axis at the soralia, becoming rolled; soredia granular, often on the "knuckles" of bent lobes; containing atranorin and gyrophoric acid (medulla KC+R); e N Am, Colorado, Arizona, and oceanic BC to Cal, rare; *H. riparia* McCune has lobes with apical powdery soredia, rhizines densely branched, and salazinic acid (medulla P+R))

## Key P: BLACKISH FILAMENTOUS

1a Filaments > 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 < 2 cm long or less than 0.1 mm in diameter; photobiont blue-green, 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; on rock (both calcareous and siliceous), possibly overlooked

[*Thermutis velutina* (Ach.) Th. Fr.]

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 siliceous rock

5a Fungal hyphae very irregular and bent, only partly coalescing; possibly fairly common but seldom coll

*Cystocoleus ebeneus* (Dillw.) Thwaites

5b Fungal hyphae parallel and straight, coalescing; widespread, not certain for our area

[*Racodium rupestre* Pers.]

3b Filaments 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 On siliceous rock; branches 1-5 mm long,  $\pm$  filamentous, cushion forming, rigidly upright, repeatedly bifurcate, 40-180  $\mu\text{m}$  thick; thallus to 5 mm high; apothecia rare; on occasionally wetted rock; Colorado and Cal

[*Lichinella stipatula* Nyl.]

8b On calcareous rock (or soil); branches 3-4 mm long, cushion forming or not; thallus

9a Photobiont layer  $\pm$  red to violet colored at the margin; thallus blackish; disk small, widening late; branches leathery-toothed; Colorado

[*Synalissa symphorea* (Ach.) Nyl.]

9b Photobiont layer yellowish at the margin; thallus olive-black but often gray pruinose; disk flat, expanded; branches not toothed; mainly sw deserts and Great Plains

[*Peccania*]

7b Photobiont filamentous (*Nostoc*, *Scytonema*, or *Stigonema*); thallus erect or decumbent

11a On rock, mosses over rock, soil, or moss over soil

12a Thallus mat forming; on rock

13a On calcareous rock where moist; spores gen 8-24/ascus; photobiont *Scytonema* (single-rowed filaments, with  $\pm$  paired, parallel branches with divergent tips, the tips not tapered); thallus threadlike, erect to decumbent, forming clumps or mats; hyphal cells  $\pm$  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; thallus in cushions 5-15 mm broad to 6 mm high; hyphae forming an irregular network; on moist noncalcareous rock; widespread, including coastal rocks and interior

*Spilonema revertens* Nyl.

(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

xa Photobiont *Stigonema*

*Spilonema* (see above)

xb Photobiont *Nostoc* or *Scytonema*

15a Spores brown, 2- to 4-celled; on soil and mosses; arctic-alpine to montane; cushion-formed from branched cephalodia, the thallus highly reduced; rare

*Solorina spongiosa* (Ach.) Anzi

15b Spores hyaline, spores multicellular to muriform; on all substrates; cushion-formed from the thallus, not cephalodia

16a On mosses over rock; spores 2-celled; thallus densely cushion forming, richly branched, with glossy round branches; apothecia usually present

*Polychidium muscicola* (Sw.) Gray

16b On various substrates including moss over rock; spores multicellular to muriform; thallus minutely fruticose or more often with fruticose projections from a dorsiventral thallus

*Leptogium*

11b On bark

18a Hyaline hairs present on branch surfaces (LM); on bark w Cas

“*Dendriscoaulon*”

[“*Dendriscoaulon*” 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 *Scytonema*; coastal SE Alaska to w Oregon; seldom collected

*Polychidium contortum* Henssen

19b Cortical cells 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, the branches 60-100  $\mu$ m wide, slightly flattened, corticate with two layers of cells; apothecia lacking photobiont in the exciple; spores nonseptate. Rare, known from mossy *Alnus* bark, Lake Ozette, Washington (Tønsberg 1999, *Evansia* 16:184)

*Santessoniella grisea* (Hue) Henssen

[The only other N Am species in this genus is *S. arctophila* (Th. Fr.) Henssen (= *Parmeliella arctophila* (Th. Fr.) Malme), known from moss, soil, and plant detritus in

Denali NP (Alaska), Hudson Bay, and the type locality in Labrador.]  
21b Thallus various, corticate with one layer of cells; spores muriform; apothecia usually with photobiont in the exciple

*Leptogium*

20b Photobiont *Gloeocapsa*, *Scytonema*, 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 (Oregon: Clatsop Co., McCune 26126)

unknown *Lichinodium*-like

22b Photobiont filamentous, *Stigonema* or *Scytonema*

23a Branches ± flattened. Branches 20-50 µm wide and to 0.2 mm long, forming tiny cushions to 3 mm across; photobiont *Scytonema*, 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 *Polychidium contortum*; Queen Charlotte Islands

*Dictyonema moorei* (Nyl.) Henssen

23b Branches round

24a Photobiont *Stigonema*, forming single- to multiple-rowed filaments; basal portions with rhizohyphae. Surface cells short-elongate, length:width about 2:1 to 4:1; Alaska to OP of Wash, coastal forests

*Spilonema* sp. 1 of Goward (1999)

24b Photobiont *Scytonema* (filaments ± paired); basal portions lacking rhizohyphae

25a 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. Alaska near Juneau s to OP, very rare inland near Clearwater BC; see Bryol 103:113.

*Spilonemella americana* Henssen & Tønberg  
(= unknown #1 of Goward 1999)

25b Branches filamentous without constrictions; exciple smooth or lacking

26a Thallus very small, < 3 mm diam, dull blackish. Cortical cells irregularly angular; coastal SE Alaska to BC, type specimen from Sicamous, BC; rare

*Lichinodium canadense* Henssen

26b Thallus usually > 3 mm diam, ± shiny gray; distribution in PNW poorly known

*Polychidium dendriscum* (Nyl.) Henssen

## Key Q: FRUTICOSE, HOLLOW STALKS

1a Stalks tipped with bright red apothecia

*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

3a Surface dull and fibrous, like matted cobwebs (use lens), cortex lacking; primary squamules absent

*Cladina*

3b Surface smooth, corticate at least in part; primary squamules often persistent

*Cladonia*

2b Stalks simple to few-branched, pointed, blunt or tipped with cups

4a Thallus wholly of erect to prostrate stalks, lacking squamules; habitat mainly subalpine to alpine

5a Thallus yellowish brown to brownish, or yellowish green, occasionally purplish brown; stalks blunt

*Dactylina*

5b Thallus white to cream; stalks pointed or blunt

6a In cold, dryish habitats; stalks pointed; apothecia absent; suberect or prostrate on alpine sod and detritus, mainly at high elevations where it is fairly frequent

*Thamnia*

6b In wet sites in coastal bogs; common in coastal Alaska, becoming rare southward

*Siphula ceratites* (Wahl.) Fr.

4b 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

*Baeomyces*

7b Podetia unbranched or branched, short or tall, often bearing squamules or soredia; primary thallus squamulose, generally persistent but sometimes disappearing

*Cladonia*

## Key R: FRUTICOSE, NOT HOLLOW STALKED

### 1a Thallus yellow to orange

#### 2a Thallus minute (gen < 2 cm long)

##### 3a Soredia present

4a Thallus dwarf erect fruticose, gen < 5 mm high; not fibrillose; on rock, both on the immediate coast and inland, most common on rock, occasionally on trees

*Xanthoria candelaria* (L.) Th. Fr.

4b Thallus small, prostrate to suberect fruticose, gen > 5 mm diameter; lobes ± fibrillose; rare in sheltered crevices in calcareous rock in cold dry habitats

*Teloschistes contortuplicatus* (Ach.) Clauz. & Rond.

##### 3b Soredia lacking

5a On seashore rocks in spray zone; occasional, Oregon s to Baja Cal

*Caloplaca coralloides* (Tuck.) Hult.  
(= *Polycaulonia c.*)

5b On woody plants

6a Thallus a knobby, short-branched, yellow to orange, typically forming compact globular clusters on twigs; apothecia gen present; abundant mainly in valleys, widespread

*Xanthoria*

6b Thallus of short, branched, orange filaments, the filaments erect and forming a mat gen < 5 mm high; apothecia absent; common on tree trunks in many habitats

*Trentepohlia* (an alga)

#### 2b Thallus medium to large (gen > 2 cm diameter)

7a Thallus orange; rare; conifers, immediate coast, Oregon (only one population known) and Cal

*Teloschistes flavicans* (Swartz) Norm.

7b Thallus bright yellow to fluorescent green; common on bark and wood, 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 (gen < 0.2 mm), unbranched or sparingly dichotomous branched, to ca. 2 mm long, closely set but not forming a continuous mass; uncommon on bark mainly on the immediate coast, especially *Pinus contorta* swales, but also in the Coast Range, Alaska to Oregon

*Loxosporopsis corallifera* Brodo, Henssen & Imsh.

13b Stalks straw-colored, cream, or white, thickish, forming a continuous mass; substrate various

14a Disk yellowish; on siliceous rocks near the seashore; central Cal to Lincoln Co., Oregon

*Cladidium bolanderi* (Tuck.) Ryan

(= *Lecanora b.*, *L. thamnitis*)

14b Disk brown to black-brown; on inland rocks; widespread, mainly montane to alpine, fairly frequent e Cas

*Lecanora argopholis* (Ach.) Ach.

(Usually this species is an unstalked areolate crust, but it occasionally develops into a stalked crust to 1 cm high)

##### 12b Thallus brown, dark brown, or blackish green

15a Spores minute (< 6 µm long), many/ascus; thallus brown above, black below, of stalked, flat-topped squamules; cortex KC+R; fairly common on rock, steppe to alpine

*Acarospora thamnina* (Tuck.) Herre

15b Spores larger, < 8/ascus; thallus and spot tests various

16a Spores hyaline, nonseptate; on siliceous rock or moss over rock

xa On moss over rock; thallus light brown

- Frutidella caesioatra*** (Schaer.) Kalb  
(= *Lecidella caesioatra* (Schaer.) Kalb; = *Lecidea caesioatra* Schaer.)
- xb On siliceous rock; thallus dark green, black, or dark brown
- 17a 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; uncommon, Cas and RM
- Lecanora pringlei*** (Tuck.) Lamb
- 17b 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
- Cornicularia normoerica*** (Gunn.) DR.
- 16b Spores brown, septate; on rock or moss over rock
- 18a Spores 1-septate, in apothecia sessile on the thallus; thallus dark brown; apothecia black, sessile; widespread but only occasional
- Buellia badia*** (Fr.) Mass.
- 18b Spores muriform, in perithecia imbedded 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; rare forms found in particular habitats, especially flat, poorly drained areas with thin soil over basalt and often *Artemisia rigida*
- Dermatocarpon***
- (vagrant forms of *D. reticulatum* Magn. and *D. minutum* (L.) Mann. will key here)
- 24b Branches round, not dorsiventral, olive, brown, greenish, or greenish gray; spores borne in apothecia but mostly sterile; thallus a prostrate branched mat or spherical and erect; widespread in semiarid steppe and grasslands
- Aspicilia***
- (including *A. reptans* (Loom.) Wetm., *A. hispida* Meresch. (= *Agrestia h.*), and *A. fruticulosa* (Eversm.) Flag)
- 23b Lobes pale greenish to yellow green (usnic acid present)
- 25a Lobes round in cross section, not dorsiventral; medulla K-, P-; rare on rocky calcareous flats at mid to high elevations, mainly in SE Idaho and Wyoming
- Rhizoplaca haydenii*** (Tuck.) W. Weber
- 25b Lobes dorsiventral, flat or rolled
- 26a Medulla K-; thallus of broad lobes that are somewhat divided and rolled under but not repeatedly branched; 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; widespread and common in semiarid areas e Cas
- 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 Cas
- Nodobryoria abbreviata*** (Müll. Arg.) Brodo & Common
- 33b Thallus pendent
- 34a Pseudocyphellae present, small punctiform; medulla and pseudocyphellae C+R, KC+R (olivetric acid); coastal Alaska and BC

- Bryocaulon pseudosatoanum* (Asah.) Kärnef.
- 34b Pseudocyphellae absent; medulla with all spot tests negative; BC S to San Diego, fairly common, especially in Cas and moist conifer forests e Cas
- Nodobryoria oregana* (Tuck.) Brodo & Common
- 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 s to n Cal; rare
- Sulcaria badia* Brodo & Hawksw.
- 37b Branches and chemistry otherwise; widespread, common
- Bryoria*
- 36b Thallus tufted
- 38a Thallus a delicate tuft, on trees or shrubs near the coast; pale to dark olive brownish or olive black; occasional in its restricted habitat
- Cetraria californica* Tuck.
- 38b Thallus and habitat otherwise; 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 in alpine habitats, mainly known from w Montana
- Nodobryoria subdivergens* (E. Dahl) Brodo & Hawksw.
- 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* (Ach.) Kärnef.
- 43b Medulla C-, KC-; thallus often forming ± compact turfs; common in arctic-alpine to exposed subalpine habitats
- Coelocaulon*
- 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, mainly in and w Cas, but inland to w Montana where it is rare
- Cornicularia normoerica* (Gunn.) DR.
- 44b Thallus of slender branches, color and spot tests various; on soil, alpine sod, or rock
- 45a Thallus gen black, pale brown or straw-colored at the base; cortex and medulla KC+R, P+ yellowish (alectorialic and barbatolic acids); arctic-alpine S to New Mexico and Wash; rare in our area
- Alectoria nigricans* (Ach.) Nyl.
- 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)
- 48a Cortex lacking; thallus whitish, of minute, delicate pseudopodetia forming a short, leprose-appearing turf; widespread, common in many open habitats
- Leprocaulon*
- 48b Cortex present; thallus color various
- 49a Thallus white, gray, olive gray, or brownish white (usnic acid lacking)
- 50a Thallus of mostly unbranched stalks, gen < 2 cm long

51a Ascocarp a mazaedium; mazaedia produced at the tips of short stalks; infrequent; usually on conifer twigs in exposed subalpine habitats

*Tholurna dissimilis* (Norm.) Norm.

51b Ascocarp not forming a mazaedium or ascocarps not found

52a Stalks (actually long isidia) < 2 mm high and < 0.2 mm thick, white; apothecia typically poorly formed or absent; primary thallus lacking cephalodia; on bark; very slender, unbranched, to ca. 2 mm long, on bark mainly on the immediate coast, especially *Pinus contorta* swales, but also in the Coast Range, rarely in Cas; Alaska to n Cal

*Loxosporopsis corallifera* Brodo, Henssen & Imshaug

52b Stalks gen > 5 mm high or > 0.5 mm thick, white or more often grayish to greenish gray, sometimes brownish in exposed habitats; apothecia usually present, round to elongate at the tips of stalks, lacking a thalline margin; primary thallus with cephalodia; on rock, rarely on wood; common w Cas, uncommon to rare e Cas, inland to n Idaho

*Pilophorus*

50b Thallus otherwise: branched, mostly > 2 cm long

54a Spores produced in a mazaedium; stalks smooth and glossy; mostly on trees

xa Stalks flattened in cross section. Rare, Alaska s to OP near the coast

*Bunodophoron melanocarpum* (Sw.) Wedin

xb Stalks roundish to irregular in cross section. Common on conifers w Cas, uncommon e Cas to Idaho, where it is rare

*Sphaerophorus*

54b 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*

49b Thallus yellowish green to pale green (containing usnic acid)

56a Main branches with a tough central cord; most spp with numerous perpendicular branchlets; widespread, common

*Usnea*

56b Main branches without a central cord; most spp with few or no perpendicular branchlets

57a Branches greenish above, whitish below, flat, dorsiventral; abundant at low elevations w Cas on virtually any substrate but mainly on trees and shrubs, rarer e Cas

*Evernia prunastri* (L.) Ach.

57b Branches not differentiated into an upper and lower surface

58a Branches becoming black spotted, relatively soft and flaccid even when dry, sorediate; rare; extreme coastal trees, occasionally rocks

*Niebla cephalota* (Tuck.) Rundel & Bowler

58b Branches not black spotted, except when parasitized or diseased, ± tough and cartilaginous when dry

59a Thallus flat to irregular in cross section; isidia lacking

60a Main branches irregularly perforate into a ± hollow interior, slender, the tips often intricately divided; thallus gen < 4 cm long; woody plants in moist forests; fairly common w Cas, uncommon e Cas

*Ramalina* (subg. *Fistulariella*)

60b Main branches not perforate into a ± hollow interior (although sometimes forming nets at the tips of the branches), narrow or broad, gen not intricately divided at tips; thallus gen 2-100 cm long; common on woody plants w Cas, rare e Cas to w Montana

*Ramalina*

59b Thallus roundish in cross section

62a Branch tips tightly curled into a tiny fiddlehead with minute terminal soralia; main branches gen < 1 mm; thallus KC-, C-; uncommon, conifer

forests near streams in mountains

*Ramalina thrausta* (Ach.) Nyl.

62b Branch tips curved or straight but not curled; main branches becoming thick (often > 1 mm); cortex and/or medulla often C+R or KC+R

63a Branches ± smooth, the cortex mostly intact, roundish or somewhat flattened or grooved in cross section; with whitish elongate often spiraling pseudocyphellae; widespread, common E to Cont Div

*Alectoria*

(Some *Bryoria* species are occasionally pale enough to key here, including some forms of *B. trichodes* ssp. *trichodes* (K-, P+R, KC-) and *B. capillaris* (thallus K+ strong Y, P+Y, KC+ pale O)

63b Branches rough and irregular, the cortex cracked and eroding; whitish spiral pseudocyphellae lacking; rare; epiphytic in BC, on alpine sod in RM

*Evernia divaricata* (L.) Ach.

## ACKNOWLEDGMENTS

This key was constructed using as a starting point Willa Noble's introductory key in "The Lichens of the Coastal Douglas-Fir Dry Subzone" (1982, PhD Thesis, Univ. British Columbia, 942 pp.). By greatly increasing the geographic scope, it has brought in many lichens from the steppe, alpine, continental forests, as well as a more southern element from coastal California. Many students and lichenologists, too numerous to list, have contributed to this key in one way or another. In particular, I would like to thank Irwin Brodo, John Davis, Chiska Derr, Trevor Goward, and Roger Rosentreter.

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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.
- bullate**: Bulging upwards, usually applied to areoles that are thick and convex, or bubble-like.
- byssoid**: 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, gen ± 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.
- 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 homoimerous where the photobiont is spread throughout the cross-section of the thallus and a white medullary band is lacking.
- homoimerous:** 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*.
- hyothallus:** (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 imbedded 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 imbedded 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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#### ABBREVIATIONS

BC	British Columbia
Cal	California
Cas	Cascade Range
Cont Div	Continental Divide
diam	diameter
elev	elevation(s)
e Cas	East of the Cascade crest
esp	especially
gen	generally
occ	occasional
OP	Olympic Peninsula
RM	Rocky Mountains
µm	micrometers
Sask	Saskatchewan
w Cas	west of the Cascade crest
Wash	Washington (state of)
<	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 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 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