LICHENS OF WEST VIRGINIA FIELD GUIDE:

ECOLOGICAL INDICATORS OF HABITAT TYPES

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INTRODUCTION. *What are lichens*? Lichens are one of the most widespread life forms on the planet (Larson 1987), and yet easily overlooked. Lichens are the result of a shared relationship between two very different organisms, an alga or cyanobacterium capable of producing food by photosynthesis and a fungus, with each providing beneficial resources to the other. When the fungus forms a partnership with the alga or cyanobacterium (both photobionts), a new composite organism is formed (with different physical and chemical properties) that can colonize habitats neither partner could colonize on its own. This partnership has sometimes been described as a mutualistic symbiosis, but the relationship is complicated and can arguably be called a "controlled parasitism" by the fungus! This is because the algae are confined to a limited layer in the lichen, where their reproduction is controlled. Lichens are often grouped with bryophytes (mosses and liverworts) in introductory treatments, but lichens are not part of the plant kingdom. Rather they are fungi that "farm" algae or cyanobacteria (formerly called blue-green algae). Sometimes lichens are placed in the informal grouping "cryptogams" (meaning "secret marriage") with bryophytes: both bryophytes and lichens (as well as ferns) reproduce by spores and not by seeds (Seeds are the reproductive units of conifers and flowering plants only). However, it should be noted that since lichen fungi incorporate photosynthetic organisms (photobionts) into their bodies (called thalli), they *behave* like slow-growing plants, making sugar from carbon dioxide pulled out of the air!

Lichens as Ecological Indicators of Habitat Types. The usefulness of lichens for monitoring air pollution (Showman and Long 1992) and levels of bio-accumulated pollutant elements (Lawrey 1993) is well known. Lichens are also valued as indicators of climate change; this is why the National Science Foundation (NSF) is currently subsidizing digitization of North American lichen collections (NSF TCN or Thematic Collection Network and ADBC or Advancing Digitization of Biological Collections). Lichens are used in monitoring programs as an indicator of forest health (Messer et al. 1991), but what about lichen species as representative of habitat types? Assessing lichen species and community composition as indicators of habitat conditions (*or in this paper, habitat types*) is usually context- and scale-dependent but can be reliable if not generalized beyond a specific regional or local scale (Will-Wolf et al. 2006). ***In this guide, the focus will only be on representative, diverse lichens of habitat types found in West Virginia (WV)***. Ecological indicators are measurable characteristics of structure (e.g. habitat), composition (*in this paper limited to lichen species*), and function of ecological systems (Niemi and MacDonald 2004), with "ecological" referring to all biotic and abiotic relationships and interactions in nature. As such, ecological indicators are primarily used to measure conditions, trends, or responses of the environment to any kind of disturbance (usually anthropogenic, i.e. human-related). As examples, certain lichens are found only in natural forests vs. managed forests in Nova Scotia (Cameron 2002), and some lichens are associated mainly with old-growth forests (e.g. Brunialti et al. 2010). However, these relationships, studied in many countries and on different scales, are neither perfect nor clear-cut (Rolstad et al. 2002). Ideally, given the complexities of nature, more than one species (lichen or otherwise) should be used to indicate a habitat type (e.g. Honnay et al. 1998), but from a practical standpoint, patterns of occurrence within a particular area for a given species may be reasonably consistent. For example, the lichen *Cladonia rangiferina,* called either Reindeer Moss (but it is not a moss!) or Reindeer Lichen (preferred) is associated with wet areas along the coast of northwestern North America yet is

otherwise more typical of open sunny sandy habitats (Brodo et al. 2001). In West Virginia, it is closely associated with dry upper slope oak stands (Carvell and Tyron 1959), and overall is most common in the WV Highlands (Flenniken 1999). In an effort to make lichens diversity and ecology accessible to land managers, private landowners, and interested public, ***we define ecological indicators for a particular habitat (e.g. shale barrens) as species that are found more commonly inside the habitat than outside it***. Habitat is simply the area in which the lichen lives, made possible by the many small-scale physical, chemical, and biological characteristics that create the environment. The purpose of this guide is to learn recognizable, common and unique lichen species based on the general habitat types they are found in and any morphological features observed in the field. Given the "cryptic" nature of lichens but their importance as foundations of some ecological systems, the guide will hopefully help you gain a newfound appreciation for these under-studied organisms!

LICHEN STRUCTURES & SUBSTRATE: A BRIEF OVERVIEW. As with identifying any kind of organism, there is no escape learning some key features and terminology. We keep terminology limited to what is necessary to identify the lichens in the field, and will introduce specific other terminology when necessary. For a comprehensive look at lichen terminology and species identification, Brodo (2016) is a great resource.

Lichen Growth Forms: The Main Body (Thallus)

Foliose

A good place to begin in understanding lichens is the overall structure (growth form) of the main body or thallus. Among the most obvious and common growth forms you will encounter are foliose lichens. These somewhat resemble leaves and leaflets, and typically lay flat (more or less) on their substrates (rocks, trees, etc.). The "leaves" or "leaflets" are actually thallus lobes that can vary in size, shape, and configuration (**Figure 1**). The lobe margins (tips or edges) are useful in identification, along with the surface of the thallus. The thallus is made up of four stratified layers: upper cortex, photobiont layer, medulla, and lower cortex. The cortex which can be thought of as a "skin" is comprised of compact fungal cells, protecting the medulla. The medulla is a looser, larger, inside layer comprised mainly of fungal threads (called hyphae, forming a mycelium).

The fungal filaments wrap around the photobionts in the thin green layer (the food-producing "farm") just below the cortex, close to the light. The cortex lets light through while still protecting the algae from drying out. The cortex may also produce colorful "sunscreen." Scratching the cortex should reveal the typically white medulla (below the green photobiont layer); that will identify the thallus as a lichen rather than a liverwort (which would be green throughout). Most of the medulla is just fungus; below the green layer food and water are moved or stored and more chemicals are manufactured.

The lower "skin" or cortex produces *rhizines* (in many lichens), that can be thought of as "roots" that anchor the lichen to the substrate. Rhizines (fungal filaments that are hair-like) can be unbranched (simple) or branched in various ways, and can be black, brown or white, all features that help in identifying lichen species (**Figure 2**). Rhizines are quite typical of foliose lichens,

although dog lichens (*Peltigera*) lack them. With or without rhizines, the lower cortex can look vastly different from the upper cortex in foliose lichens. Typically foliose lichens (unlike crustose lichens) can be pried loose from their substrates with a knife.

Figure 1. Foliose lichens can have smooth, warty, cracked, or hammered-looking surfaces, and the lobe margins can be flat, curled, or even contain cilia ("eyelash" fungal hairs as in *Parmotrema*, on left). Notice the pale greenish color of the thalli with white fungal mycelium revealed by the cracks (in *Parmelia sulcata*, on right) that permit gas exchange. Lichens produce an extraordinary array of chemicals (defensive, water-repelling, sunscreens) which also affect color.

Figure 2. An example of simple brown rhizines (*Punctelia caseana*, on left) and a dense mat of short, black rhizines (*Umbilicaria americana*, on right).

Fruticose

Fruticose lichens are shrubby, tree-like, or hair-lichen lichens that are often weakly attached to the substrate (no rhizines, though some species have sticky disks). They can be erect or hanging (pendulous) from the substrate **(Figure 3).** Thalli can be hollow or solid, cylindrical or flattened, branched or unbranched, depending on species. Upper and lower surfaces are typically very similar. As with foliose lichens, colors vary greatly, depending on chemicals produced.

Figure 3. A Reindeer Lichen (*Cladonia rangiferina*) and Bristly Beard Lichen (*Usnea hirta*) with fruticose growth forms. The reindeer lichen grows upright from the ground while the Bristly Beard Lichen hangs off the side of a tree.

Squamulose

Squamulose lichens are in between foliose and crustose lichens. They are made up of small scales or "squamules", or "areolae", meaning small thallus lobes, which are sometimes called "sod flakes" in lichens growing on soil (sod). Prying these flaky lichens (which typically lack a lower cortex) off the substrate with a knife can be more difficult than with foliose lichens. Some squamulose lichens are strictly squamulose, whereas other species display a "secondary thallus" of upright stalks called podetia that rise above the squamules.

Figure 4. Two examples of *Cladonia*, a diverse genus of fruticose lichens. Many species have a squamulose primary thallus and a fruticose secondary thallus of podetia; the term Cladonia-form can be used for this "double life". The podetia are stalks that can grow indefinitely, harvesting light and making sugar. Sometimes at maturity they produce apothecia (spore-producing structures) which are brown or bright red in some species.

Crustose

As the name implies, crustose lichens have a very thin thallus (thick as a coat of paint) that tightly adheres to the substrate (e.g., rock). They have an upper cortex or skin (sometimes brightly colored and resembling paint) but lack a lower cortex. The medulla (including the upper photobiont layer) grows directly on and into the substrate, remarkably in between the grains of a rock. Since crustose lichens lack a lower cortex, they cannot be removed intact from the

substrate with a knife (Lichenologists use rock hammers!). Dust lichens, also called *leprose* lichens, can be grouped with crustose lichens ("crustose-leprose"), but they are quite distinctive. Stratified layers (distinct cortex and medulla) are generally lacking in dust lichens, and fungal and algae cells are mixed together in a continuous layer or in clumps that resemble dust-bunnies (**Figure 5**).

Figure 5. An example of a crustose lichen growing on rock with two stratified layers and apothecia (left, *Porpidia albo-caerulescens*), and a dust lichen (right) which lacks these layers and can be brushed off the substrate with a finger.

Lichen Reproductive/Fruiting Structures

Soredia

These are powdery clumps of fungal hyphae and photobionts, all that is needed to start a new lichen, given the right habitat away from the parent lichen. Soredia burst out of the lichen from the upper medulla when there are breaks in the overlying cortex (skin). Patches of soredia (called soralia) may form balls, stripes, or other shapes, either scattered over the thallus surface or restricted to thallus edges or other locations, depending on lichen species. Soredia should be one of the first things you look for with your hand-lens! Soredia are carried by wind, water, or animals (such as mites!) to new locations where a new lichen thallus can develop from this special "dust". Soredia are one of the most important means of asexual reproduction in lichens, i.e., reproduction from thallus fragments, soredia being the smallest possible fragments.

Figure 6. A close up of soredia (grouped into soralia) on a lobe margin (left) and on lichen branches (right).

Isidia

Isidia (**Figure 7**) and soredia are the two most important means of asexual reproduction in lichens; both are very small fragments containing fungi and photobionts. Look very closely with your hand-lens and you can tell them apart: unlike soredia, isidia have an outer cortex that may be quite shiny. Isidia are more complete "starter lichens" than are soredia. They can resemble mini hot dogs, fingers, or even branching corals. When identifying lichens look to see isidia are present and whether they are sprinkled over the whole thallus or limited to margins, branches, or other locations.

Figure 7. Finger-like isidia are growing out of soredia on a lichen branch (left) and on a lobe margin (right). Note that the isidia have an outer skin (cortex) similar to the main thallus, whereas the soredia lack a skin and appear powdery, granular, or cottony. In some species isidia tips are black.

Fragments

Many lichen species achieve remarkably broad distributions through distribution of fragments (including isidia and soredia) with the help of wind, water, and animals. Although accidental dispersal (e.g., soredia sticking to fur) is probably the most common dispersal mode by animals, lacewing larvae deliberately cover themselves with lichen fragments to disguise themselves as both predators (of smaller insects) and prey (for birds). Watch for these small, round "walking lichens" on trees!

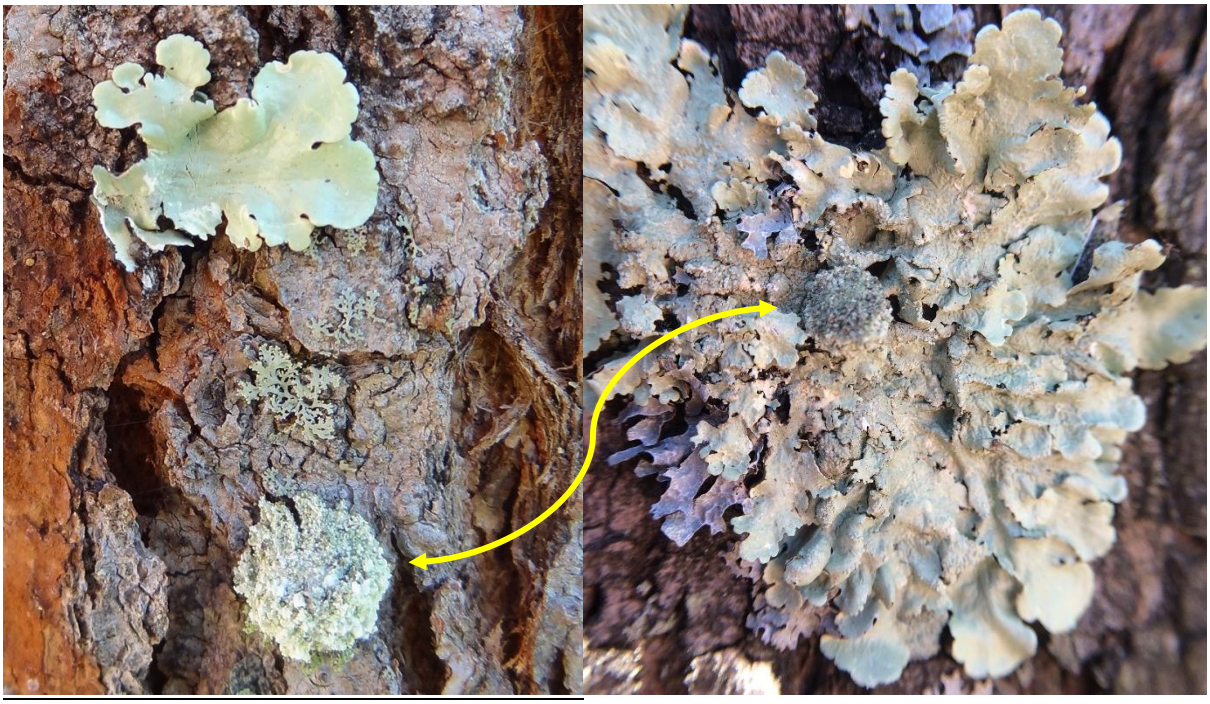


Figure 8. Lacewing larva camouflaged as a lichen colony. Friendship Hill National Historic Site, Pennsylvania, October 2017.

Photo credit (left image): Susan Studlar

Apothecia

An apothecium (plural apothecia) is typically a cup-like structure that is produced during sexual reproduction of the lichen fungus. After mating of male and female fungal strains, spores with recombinant genes are produced in specialized sacs (called asci). The spores are explosively discharged into the fungal cups (made from hyphae) and then splashed out by rain. A lucky fungal spore is carried by wind, water, or animals to a new location where it meet ups with the "right" strain of algae or cyanobacteria and starts up a new lichen (a remarkable process that has been directly observed). Thus the lichen as a symbiotic unit cannot itself reproduce by sexual reproduction - but this roundabout method accomplishes the same evolutionary end: variable offspring that may be fit to survive in changing environments. The vast majority of lichens can potentially produce apothecia and are classified as Cup Fungi (Ascomycetes); a minority are more closely related to mushrooms or other fungi. In foliose lichens, apothecia often form typical cups whereas in fruticose lichens the apothecia (containing spore sacs) are often are lumpy colorful areas on top of upright stalks or podetia (**Figure 9,** left and right, respectively).

Figure 9. Several examples of apothecia either as mini disks or cups (typical form), or on top of stalks for *squamulose lichens.*

Lichen Substrates

Lichen substrates are simply the surface on which the lichen lives. Many lichens live on only one substrate type, whether it be soil, rock, or bark. While many lichens grow on multiple substrates, we placed the lichen with the substrate on which it most commonly grows.

VIEWING LICHENS IN THE FIELD (OR AT HOME): IDENTIFICATION AND PHOTOGRAPHY. A hand lens of 10–20x power is necessary to thoroughly explore the "lichenverse" (**Figure 10**). It is a common mistake for people to bring an object into focus with a hand lens by moving the lens back and forth from the eye. Since a hand lens has a fixed focal length, it is best to keep the hand lens as close to your eye as possible and then move yourself (as opposed to the lens) as close as necessary to the object until the lichen comes into sharp focus- this means you may be up to your nose in lichens! Proper lighting is key to seeing fine detail, so you may need to reorient your body so the light's path to the lichen won't be blocked.

Figure 10. A 10x and 20x power hand lens useful for identifying not only lichens but other flora and fauna close up.

As a novice you may doubt what you initially saw and may want a photo for further reference. Since most people carry a cellphone with them these days, you can buy a clip-on macro lens (**Figure 11**) for your phone for <$20 (no $500 digital SLR setup required!).

Figure 11. An example of a clip-on macro lens for a cellphone that are fairly cheap. The great majority of field photos in this guide were taken by using this method.

If you decide to really get into studying lichens or have access to one, a dissecting microscope will open up a whole other world of lichen detail and appreciation. There are universal "digi-scoping" adaptors (surprisingly reasonably priced!) that can be added to your microscope where you can take pictures of what you are viewing (**Figure 12**).

Figure 12. An example of the digi-scoping setup used by the author to take all dissecting scope photos in this guide. Photos were taken under the microscope when a field photo could not be made.

HABITAT TYPES. Habitat is simply the area in which the lichen lives, made possible by the many small-scale physical, chemical, and biological characteristics that create the environment. Our objective was to illustrate representative lichens as ecological indicators of general habitat types found in WV. We define ecological indicators as species that are found more commonly inside the habitat than outside it. There are a plethora of lichens (and habitats) left to explore beyond what we covered here. However, we hope this field guide will serve as a starting point for appreciating lichen diversity: in species, growth forms, and habitats. Lichen species are arranged first by habitat type, and second by growth forms (within each habitat type). Substrate (what the lichen grows on) is such an important aspect of habitat that we list it separately, right below overall habitat.

Rocky Habitat (Cliffs, Slopes, Emergent Rocks) – Pages 1–15. West Virginia has many cliffs, slopes, and rock outcrops to explore given its mountainous topography (**Figure 13**). Some lichens will only grow on certain rock types, within a particular environment (e.g. sandstone boulder in shady forest). Almost all of the bedrock in WV is sedimentary: limestone, sandstone, and shale (Mullenex 2013). Limestone is calcareous rock whereas sandstone and shale (defined by particle size) are typically siliceous (and relatively acidic) in WV. You can tell limestone from other sedimentary rocks by dropping a small piece in apple cider vinegar; it should release bubbles of carbon dioxide from the calcium carbonate. Arguably, WV has a land surface more rugged overall than any US region east of the Rockies (Adkins 2010c). The state's land surface is characterized by long narrow ridges and long narrow valleys (Adkins 2010a), and is the only state located completely within the Appalachians. Almost two-thirds of WV consists of the Allegheny Plateau (Appalachian Mountains section of the Appalachian Plateau), known for its sandstone ridges and shale valleys (Adkins 2010a, Stephenson 1993). The Eastern Panhandle is in the Ridge and Valley section of the Appalachian Mountains (Adkins 2010b, Stephenson 1993). A belt of igneous and metamorphic rock occurs in the Blue Ridge Mountain section of the Appalachian Mountains on the eastern border of Jefferson County (Adkins 2010a). Igneous rock can form from cooling magma, an example of this rock type being granite. Metamorphic rock is formed from great heat or pressure, two examples being slate and marble

Figure 13. An example of boulders (large emergent sedimentary rocks) in a partially shaded forest where certain lichen species can be found due to rock type and the microenvironment.

Shale Barrens – Page 16. Shale barrens are a unique habitat type in West Virginia (**Figure 14**) consisting of hot, dry, open areas on steep south or west facing slopes (Vanderhorst 2005; Grafton 2010). There are unique plants only found in this habitat type, and several lichens have been collected regularly in the shale barrens due to its bare, sandy soil and shale substrate. Therefore many of the lichens found here are adapted to a relatively dry environment since there are relatively few trees in these "sunny islands" in the middle of mixed deciduous-evergreen forests of eastern WV.

Figure 14. An example of the open, arid habitat where certain types of lichens thrive.

Photo credit: Jim Vanderhorst, WVDNR

Forest and Woodlands (Deciduous, Evergreen, Mixed, High Elevation, Open) – Pages 17–51. Mountainous terrain, mid-latitude location, and ample rainfall support varied forest vegetation cover in WV (Adkins 2010b). Despite being almost completely deforested a century ago, over 80% of WV is reforested (Gillespie 2012). Lichens can associate either with hardwoods (e.g., oaks and hickories) or softwoods (e.g. spruce and pines), and some only do well in partially shaded vs. open forest. Some lichens can also be found in forest at higher elevations (e.g., in spruce forest, **Figure 15**). WV is located in the Appalachian Highlands, where there are 40 peaks >4000 feet (1220 m) above sea level (Adkins 2010a).

There are many open forests and woodlands in WV, which are not due strictly to ephemeral, natural disturbances (e.g., ice or wind storm) but could also be related to previous anthropogenic (human-related) disturbance (e.g., road construction). For simplicity, we place lichens found in both open woods (anthropogenic or "natural") and roadsides in the "open woods" category.

Figure 15. A view from Spruce Knob, the highest elevation point in WV at 4861 feet (1496 m). Spruce Knob is home to some old growth red spruce forest, and some lichens are associated to these high elevation forested communities.

Old Growth & Mature Forest – Pages 52–54. By the early 20th century, about 55% of the original forests in WV were deforested Even so, some scattered remnants remain of old growth forests. Cathedral State Park for instance has a mixture of old-growth conifers and hardwoods (**Figure 16**). Over a half-million acres of red spruce forest covered WV which was slashed and burned or timbered by the 1920's but a small stand of old-growth spruce remains at Gaudineer Knob (Rentch 2017).

Fortunately, many areas have been reforested since then with secondary and third-growth stands. Over 80% of WV is now forested (Gillespie 2012), which increases the chances of finding a mature, relatively undisturbed forest or woodland. A few lichen species are representative of old growth and mature forests, being sensitive to air pollution and habitat disturbance.

Figure 16. Cathedral State Park is among the few places in WV with remnant old growth hemlock stands. If you see pale yellowish or yellowish-green splotches on an old hemlock (as in the foreground), examine them with your hand-lens to see if they are *pin lichens*, which are characteristic of old growth. The tiny "pins" (reproductive structures) emerge from a thin crustose thallus. Alternatively, the splotches could simply be algae or “leprarioid-crustose” lichens.

Photo credit: Susan Studlar

Aquatic Habitat (Wetlands, Stream Corridors, Persistent Wet Areas) – Pages 55–56. There are lichens specially adapted to wetlands (marshes and swamps, flooded part of the year) and aquatic habitats (notably streams, **Figure 17**). Wetlands are uncommon in WV, and make up on 0.5% of the total land area (Vanderhorst 2010) due to both habitat loss and WV's mountainous terrain. Small wetlands can be found throughout WV, but our largest wetlands are found in Canaan Valley. Although low in cover, wetlands contribute some of the highest floral and faunal biodiversity in the state (Vanderhorst 2010). You are much more likely to stumble upon a stream than a wetland, since WV has one of the highest stream densities in North America, with streams belonging to either the Ohio or Potomac River drainage basins (Petty 2010). Ephemeral, intermittent and perennial streams all have distinctive lichen communities. Many lichens grow on streamside boulders and trees where lichens can "drink" the water vapor or benefit from being splashed by liquid water (which cyanolichens require). A few lichens can tolerate being submerged for long time periods, such as the streamside stippleback, *Dermatocarpon luridum*.

Figure 17. Dendritic stream networks are inherent to many forests in WV with specially adapted lichens in or near the stream corridor.

Human-altered Landscapes (Farms, Roadsides, Urban and Disturbed Areas) – Pages 57–61. Landscapes altered by humans provide habitats for many lichen species. Although WV is mainly forest, there is good farm land in The Eastern Panhandle and Ohio River valley counties, and about one-third of WV is considered urban (Adkins 2010b). Agricultural and urban landscapes, including roadsides, have open, sunny areas that can favor lichen growth, if moisture levels are favorable. In **Figure 18** note the light-colored lichen cloak on the trees by the farm pond. Some lichens (such as the pink earth lichen, *Dibaeis roseus*) are pioneers on disturbed, trampled ground along woodland edges or on roadbanks. Lichen diversity drops in the polluted interiors of cities, but rises again when pollution levels are reduced; only a few lichens (often crustose) can tolerate high pollution levels (Purvis 2007).

Figure 18. Lantz Farm in Wetzel County, WV is an example of an old farm that provides sunny, open areas for lichens with high humidity (by ponds) that favor lichen growth.

Rock Rosette Lichen (*Physcia subtilis*)

--Habitat: Exposed sandstone and granite rocky areas

--Substrate: Siliceous rock

--Isidia: None

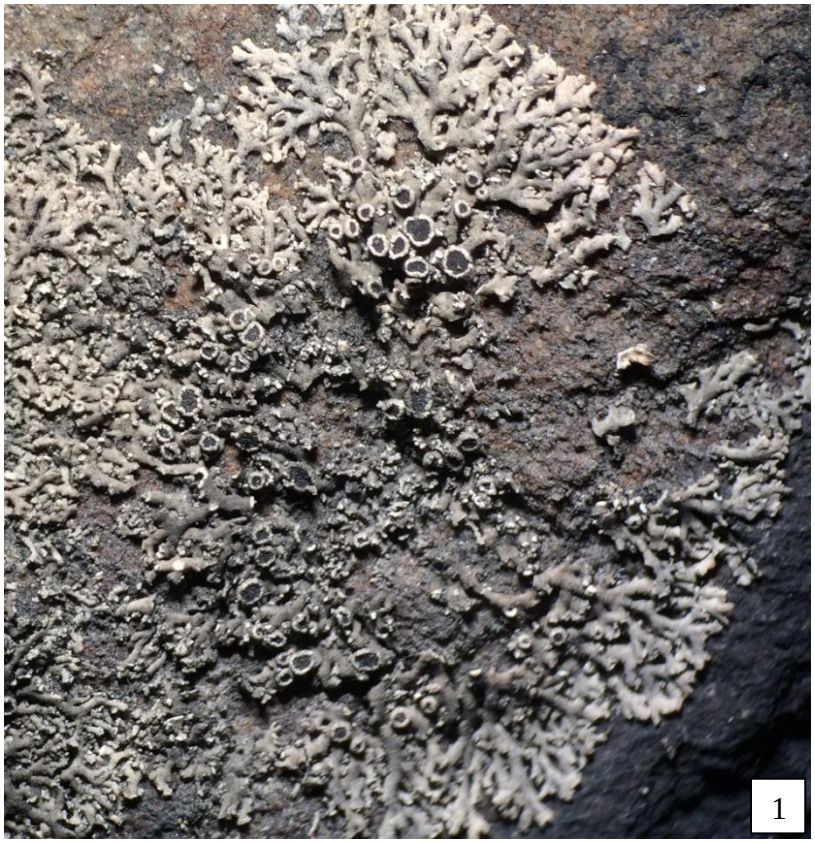
--Soredia: Around and under lobe tips, coarse

--Apothecia: Brown, disc rim same color as thallus[3]

--Rhizines: Sparse and pale in color, sometimes darkening at tips

--Distinctive Features: Light mineral gray thallus[1] (underside white) hugs rock rightly with finely branched linear, elongate lobes[2] which are longer than they are wide. The tips of lobes are slightly finger-like.

--Notes: *Physcia halei* looks similar but lacks soredia.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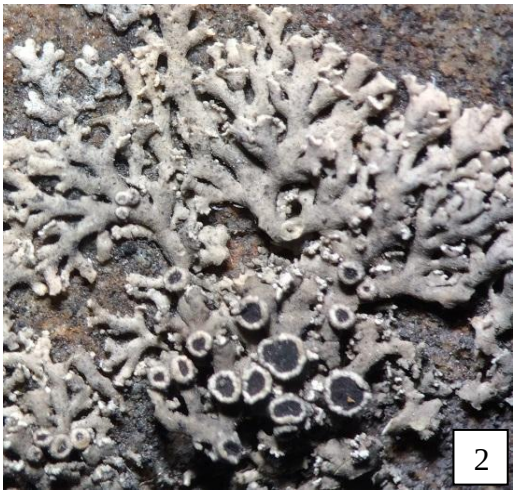
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Pitted Stone Lichen (*Bagliettoa calciseda*, syn. *Verrucaria calciseda*)

--Habitat: Exposed limestone rocks

--Substrate: Calcareous rock

--Isidia & Soredia: None

--Distinctive Features: Resembles a cratered (pitted) landscape, or a dried-up sponge[4]. Thallus is a thin, indistinctive whitish, sandy-gray stain. It is largely endolithic, meaning most of the lichen lives inside the rock. Small black perithecia (sunken flasks that contain spore sacs or asci) mature, decay, and fall away, leaving the namesake empty pits behind[5].

--Notes: In *Verrucaria muralis* perithecia are larger and only half-immersed into rock.


4


5

Peppered Rock Shield (*Xanthoparmelia conspersa*)

--Habitat: Boulders and exposed rocks, often along streams and on foggy ridge-tops

--Substrate: Siliceous rock (sandstone)

--Isidia: "Pepper" the thallus, usually black tipped[7]

--Soredia: None

--Apothecia: Common, darker brown disc[8]

--Rhizines: Simple, black

--Distinctive Features: Shiny yellow-green thallus is isidiate, giving it a peppered look. Amount of "pepper" (isidia) is moderate to too heavy. Isidia are simple to branched, often black-tipped. Lobes sublinear with squared-off tips and sometimes overlapping[6]. Usually closely adhering to substrate with undersurface black.

--Notes: *X. plitti* will have a pale undersurface.


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7


8

Plitt's Rock Shield, **Peppered Rock Shield Lichen** (*Xanthoparmelia plittii*)

--Habitat: Exposed horizontal and sloping rocks

Substrate: Siliceous rock (sandstone)

--Isidia: Thallus with abundant isidia (except at extreme lobe tips), sometimes brown-tipped[10], becoming branched with age

--Soredia: None

--Apothecia: Occasional, brown discs with edges often isidiate

--Rhizines: Simple, short, thick, and same color as upper surface where attached

--Distinctive Features: Thallus yellow-green above (with paler edges) and isidiate above[9], and pale to brown below; adhering closely to rock. Narrow somewhat square-tipped lobes often overlap.

The two **isidiate** species of *Xanthoparmelia* that you are most likely to see are *X. conspersa* (black below) and *X. plittii* (pale below). However, there are 5 non-isidiate *Xanthoparmelia species* in WV (Flenniken 1999); in the field, call them *Xanthoparmelia* sp. ("sp" means species unknown without lab tests).


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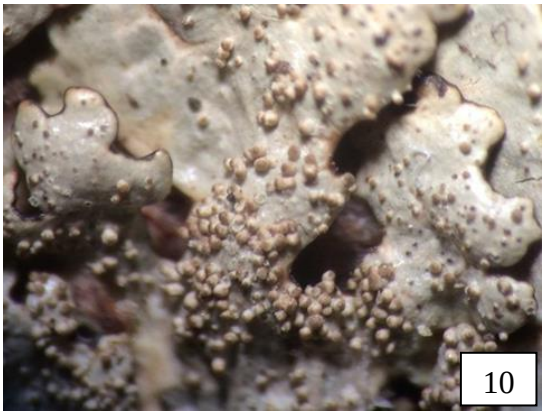
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Tattered Jellyskin Lichen (*Leptogium lichenoides*)

--Habitat: Open rocky areas often close to streams or in foggy areas

--Substrate: Calcareous rock (limestone), sometimes soil among mosses

--Isidia & Soredia: None (but lobes can look like isidia)

--Apothecia: Evidently uncommon to absent in Eastern North America (Flenniken 1999, Hinds and Hinds 2007), reddish brown

--Distinctive Features: Minute, wrinkled thallus with tattered margins[11], often growing on or among mosses. The lead-gray to purple-brown lobes are very irregular and narrow (like little broccoli florets) and at first glance may look isidiate (but true isidia are lacking)[12]. Both lower and upper surfaces are covered with a thin skin (cortex) only one cell thick (hence jellyskin; jelly lichens such as *Collema* lack a skin). The thallus is jelly-like when wet because the photobiont is a cyanobacterium (*Nostoc*) that comprises most of the thallus; fungal hyphae are scattered within a sugary jelly produced by the photobiont. Thus, jellyskin and jelly lichens are "cyanolichens" with a blue-green photobiont; typical "chlorolichens" have a thin green algal zone above the fungal medulla. Cyanolichens in general prefer wet calcareous (often mossy) habitats because that is what the cyanobacterial partner prefers.

--Notes: Species of Jellyskin and jelly lichens can be hard to tell apart, especially when wet and gelatinous. *Leptogium lichenoides* belongs to a difficult group with perhaps more species than currently recognized. *Leptogium cyanescens*, the most common species in WV and North America (Flenniken 1999, Brodo et al. 2001), is blue-gray, unwrinkled, relatively large-lobed and has true isidia.


11


12

Plated Rock Tripe (*Umbilicaria muehlenbergii*)

--Habitat: Exposed boulders and steep rock walls in mountains

--Substrate: Siliceous rock (sandstone)

--Isidia & Soredia: None

--Apothecia: Sunken in pits on the upper surface, black

--Distinctive Features: Large, smooth and wavy reddish-brown circular thallus that has pits on the surface[13]. Apothecia look like raisins or a (fictional) baby Tremor worm bursting from the ground[14]. Undersurface black with weaved plate and grill-like structures[15], and a centrally attached (umbilicate) holdfast.

--Notes: The other *Umbilicaria* species in WV have dense black hair-like "rhizomorphs" below. The rhizomorphs are not the same as rhizines since they do *not* anchor the thallus (only the umbilicus does). Rhizomorphs trap water and nutrients.


13


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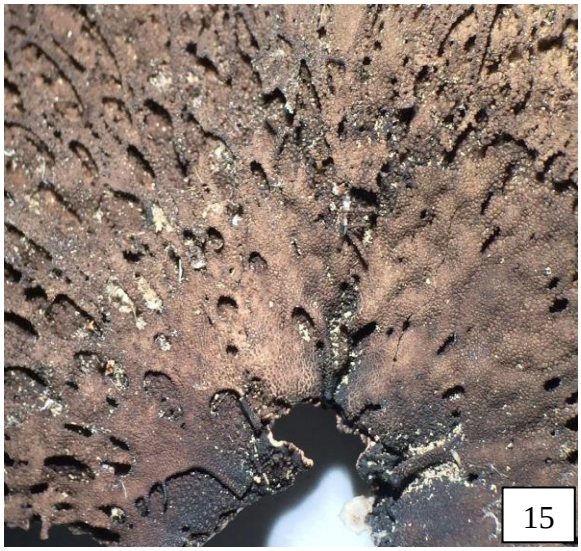

15

Frosted Rock Tripe (*Umbilicaria americana*)

--Habitat: Steep, vertical, rock faces and cliffs, somewhat shaded, with trickling water often present

--Substrate: Siliceous rock

--Isidia & Soredia: None

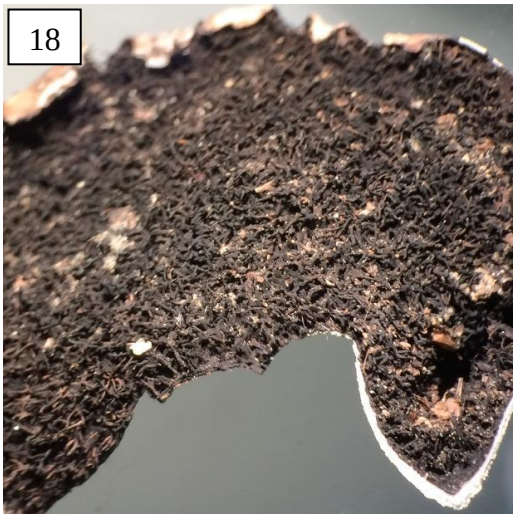
--Apothecia: Rare, black and sessile[17], not in pits

--Rhizines: Rhizines are lacking but rhizine-like short black rhizomorphs are interspersed with longer brown rhizomorphs, dense at the thallus edge[18]. Rhizomorphs are cloaked with black granules that may serve as asexual propagules after trapping algae (Hinds and Hinds 2007).

--Distinctive Features: Thalli may resemble potato chips spray-painted white through a wire mesh, or whitish cardboard[16]. The white "paint" or "frosting" is actually a thin, reflective chemical coating (calcium oxalate) called pruina[19].

--Notes: There are three *Umbilicaria* species in WV. Although *U. mammulata* is brown and lacks pruina, in the shade it can be pale (little melanin) and somewhat resemble frosted rock tripe. Check for the thick texture and two sizes of rhizomorphs found in *U. americana.*


16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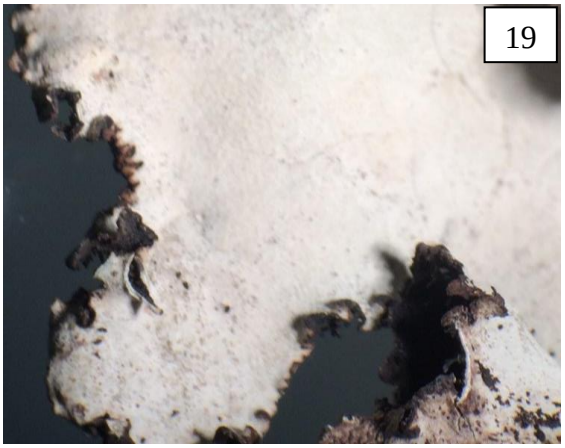
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17

Common Toadskin (*Lasallia papulosa*)

--Habitat: Rocky areas and cliffs, more common at higher elevations

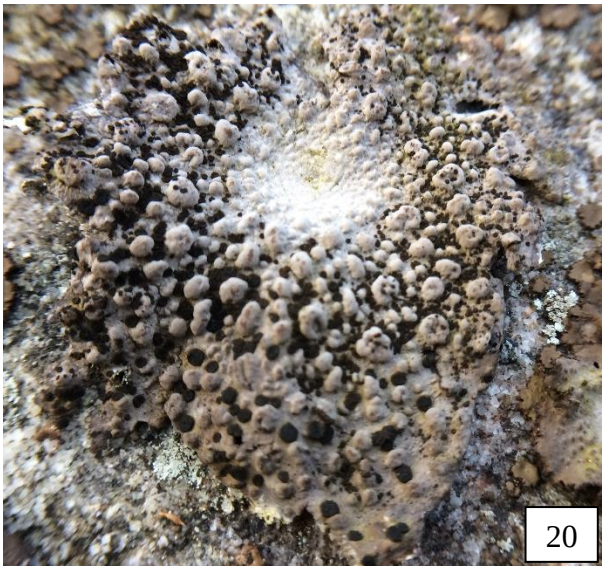
--Substrate: Siliceous rocks (sandstone), often on horizontal or sloping surfaces

--Isidia & Soredia: None

--Apothecia: Black, small, button-like[23], and sprinkled over the surface

--Distinctive Features: Resembles a gray (to pale brown) leathery pelt from a warty toad displayed on a rock[20]. Thallus undulates and becomes bright green when moistened[21]. Undersurface is paler in color, with dimples below matching the blisters on top[22]; has a central holdfast (umbilicus).

--Notes: *Lasallia pensylvanica* is has a jet-black undersurface. Rock tripes (*Umbilicaria* and *Lasallia*) can produce a purple dye when soaked with urine or ammonia for a few weeks.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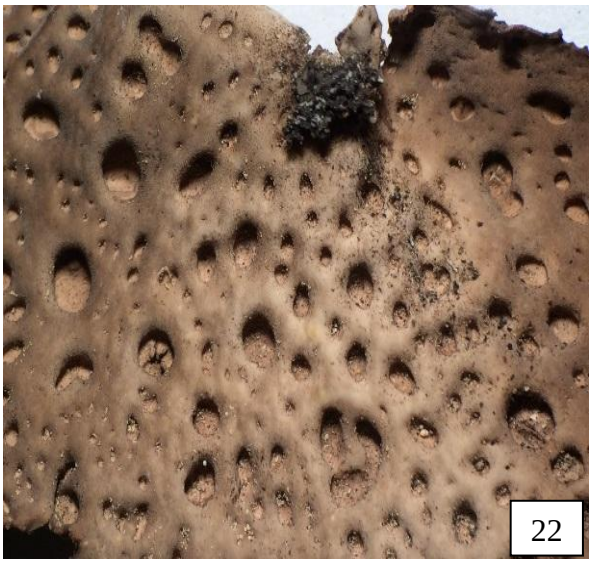
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23

Blackened Toadskin (*Lasallia pennsylvanica*)

--Habitat: Higher elevation rock ledges, outcrops, and boulders

--Substrate: Rock

--Isidia & Soredia: None

--Apothecia: Small black scattered discs[24]

--Distinctive Features: Lower surface black, upper surface brown, warty and blistered with lobes that vary from rounded to jagged and lacerated[24]; basically looks like toad's skin! Upper surface changes to bright green when wet (fungi becomes transparent, revealing algal partner). Lower surface has depressions where the pustules are on surface[25]. No rhizines but has a unique umbilical-like attachment or holdfast.

--Notes: *Lasallia papulosa* has a pale to light brown undersurface. *Umbilicaria* species have rhizomorphs below.

24

25

Common Stippleback, Leather Lichen (*Dermatocarpum miniatum*)

--Habitat: Rock outcrops, cliffs, tombstones; relatively dry

--Substrate: Calcareous rock (limestone or calcareous sandstone)

--Isidia & Soredia: None

--Distinctive Features: Round, umbilicate gray thalli (dull greenish-gray when wet) resemble a cluster of stale potato chips[26]. The upper surface is sprinkled with black dots that are the openings of the perithecia[26]: sunken flask-shaped structures that release fungal spores. Thallus may start out as a simple disc with a single umbilicus (holdfast) but later develop overlapping lobes with multiple holdfasts. Color of upper surface may vary due to chemical frosting (pruina): brownish to grayish to reddish[27]. Undersurface (below right) is brown and either smooth or warty.

--Notes: Unlike *D. luridum* which prefers wet habitats and turns bright green when wet, *D. miniatum* usually is in very dry, sunny areas and remains dull when wet. Young thalli resemble baby rock tripes (*Umbilicaria*) but can be distinguished by lack of black felt (rhizomorphs) below and presence of perithecia above.

26

27

Rock Strap Lichen (*Ramalina intermedia*)

--Habitat: Shaded rocks, boulders, cliffs, and overhanging ledges

--Substrate: Siliceous rock

--Isidia: None

--Soredia: Mostly at terminal ends of thallus branches but also dotting the margins, in grainy soralia[29]

--Distinctive Features: Shiny, tufted, light yellow-green, and with a smooth cortex[28]. With a narrow central holdfast and a tree-like "canopy" of flattened finely divided branches dotted with soredia, the rock *Ramalina* almost resembles a bush decorated with lights.

--Notes: *Ramalina* species are typically found on trees; the rock *Ramalina* is unusual. *Ramalina pollinaria* is at home on both rocks and trees, but has relatively wide strap-like thalli.

28

29

Olive Cladonia (*Cladonia strepsilis*)

--Habitat: Rock outcrops

--Substrate: Thin dry acidic soil over siliceous rocks

--Isidia & Soredia: None

--Apothecia: Uncommon and easy to overlook; stunted podetia bear clustered brown apothecia[31].

--Distinctive Features: Strap-like gray-green to brownish squamules[30, 32] multiply indefinitely and may become compacted into balls ("vagrant lichens") that roll across the landscape and may establish in new locations.

--Notes: Several other *Cladonia* species, including *Cladonia apodocarpa,* Stalkless Cladonia (upper left) have similar relatively large strap-like persistent squamules and very short podetia. Note the loss of green color in the dried herbarium specimen of *C.* strepsilis, due to death of the "farmed" algae. A chemical spot test is needed for a complete diagnosis (a drop of bleach on the thallus will produce a green color, indicating the chemical strepsilin).

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Photo Credit: Susan Studlar (Pennsylvania)

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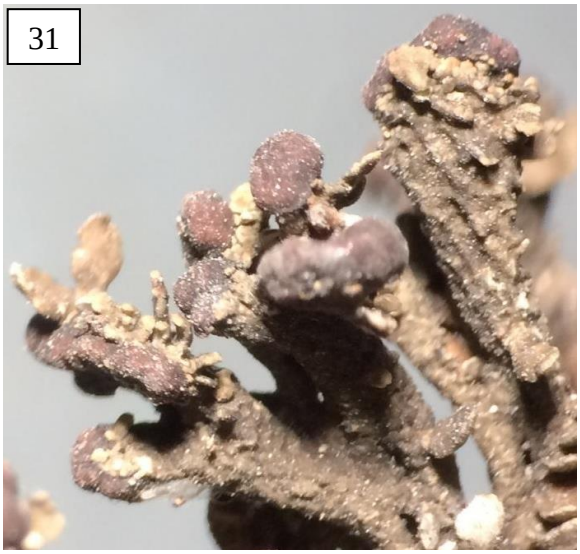


32

Smoky-eye Boulder Lichen (*Porpidia albo-caerulescens*)

--Habitat: Shaded rocks and boulders in woods

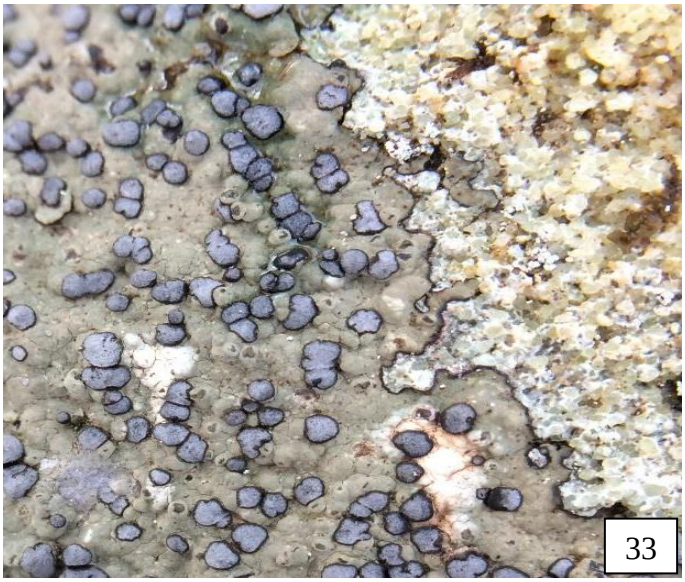
Substrate: Siliceous rock (sandstone)

--Isidia & Soredia: None

--Apothecia: Gray disks with black margins[34]

--Distinctive Features: Thallus creamy porridge gray to greenish gray and smooth to cracked (areolate)[33, 35]. Disks of apothecia gray with black margins due to thick white "frosting" (pruina) that covers apothecia except for the rims.

--Notes: The "smoky eyes" (apothecia) and shady habitat make this one of the most recognizable of crustose species in Eastern North America.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35

Island Gold Dust Lichen (*Chrysothrix insulizans*)

--Habitat: Steep cliff faces and rock outcrops, often exposed but shaded by overhangs (e.g., New River Gorge)

--Substrate: Siliceous rock

--Isidia & Soredia: None

--Apothecia: Not known

--Distinctive Features: This is a crustose-leprose lichen, a golden "dust lichen", lumped with *Lepraria* before it was clearly described by Harris and Ladd (2008). It grows as granular-sorediate patches on rock[36]; larger patches (several cm across) are subdivided by cracks (rimose-areolate) and smaller patches occur as little "islands" or outliers[37]. The sorediate yellow thalli may remind you of powdery yellow turmeric spice.

--Notes: A thallus made up of golden "islands" of soredia makes *C. insulizans* look quite different from other golden leprose lichens, although chemical tests are needed for a final diagnosis. As in all leprose lichens, *C. insulizans* is specialized for asexual reproduction. The "gold dust" propagules are transported by wind, water, and animals to new sites.

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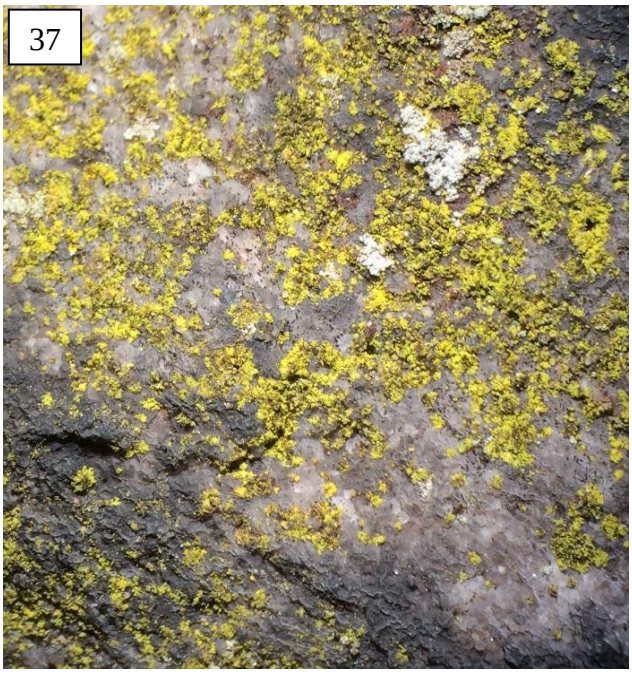

Stonewall rim-lichen (*Protoparmeliopsis muralis* syn. *Lecanora muralis*)

--Habitat: Exposed cliffs and stone walls

--Substrate: Calcareous rock (limestone and concrete), often enriched by birds

--Isidia & Soredia: None

--Apothecia: Common, yellow to yellow-tan non-powdery disc with lighter rim[41]. They are usually clustered in center of thallus.

--Distinctive Features: Yellowish-green thallus adheres tightly to rock and is lobate-crustose to squamulose. In the center, it displays flakes or areolae that resemble jigsaw puzzle pieces[38], at the edges it is lobed and *almost* foliose (no rhizines!)[39, 40]. Waxy and shiny, it can resemble dried chewing gum.

--Notes: Originally described as *Lecanora muralis*, now regarded as a complex of species, *P. muralis* thrives in the urban and agricultural settings.


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Sand-loving Iceland Lichen (*Cetraria arenaria*)

--Habitat: Shale barrens, sunny location at high elevations

--Substrate: Sandy acidic soil

--Isidia & Soredia: None, although marginal spikes may resemble large isidia[44]

--Apothecia: Rare, reddish brown on lope tips[43]

--Distinctive Features: This shrubby olive-brown to green (when alive) lichen, loosely attached to the soil, looks like a tangled mass of forking greenish-brown spiky straps that have a tendency to curl inward (caniculate)[42]. The marginal white stripes (pseudocyphellae)[42, 44] help distinguish it from the very similar boreal True Icelandic Lichen, *C. islandica* (which has more extensive pseudocyphellae). With pale undersides and a semi-erect habit, *C. arenaria & C. islandica* can be regarded as either fruticose or semi-erect foliose lichens!

--Notes: *C. arenaria*, when encountered at high elevations, reminds us of the northern affinities of the WV lichen flora. In the north, true Icelandic Lichen is important winter food for caribou and a source of antibiotics and a thickener (after bitter principles are removed) for soups and desserts. In WV there is only one *Cetraria* species, versus multiple species in the North.

Photo credit: Susan Studlar, May 2014 (Blackwater Falls SP)

Fringe Wrinkle Lichen, Variable Wrinkle Lichen (*Tuckermanopsis ciliaris* Group)

--Habitat: Coniferous and hardwood forest

--Substrate: Bark, old wood

--Isidia & Soredia: None

--Apothecia: Common, flat, and variable brown on lobe margins[47]

--Rhizines: Occasional, simple, pale and scattered

--Distinctive Features: Loosely attached, shiny, slightly wrinkled, with irregular lobes and crispy margins[45] that often bear hair-like cilia and erect finger-like projections containing pycnidia (flask-like structures producing either sexual or asexual fungal propagules)[46]. Upper thallus variable green to greenish-brown to brown with paler undersurface (the lichen that looks like it went through a lawn mower and is having a bad day).

--Notes: The *Tuckermanopsis ciliaris* Group is comprised of several species that look very similar and require chemical tests to tell part. However, *T. americana* glows blue-white under UV light whereas *T. cilaris* does not.

Photo credit: Susan Studlar, May 2014 (Blackwater Falls SP)

Hooded Tube Lichen (*Hypgogymnia physodes* syn. *Parmelia physodes*)

--Habitat: High elevation forest, coniferous forest

--Substrate: Bark

--Isidia: None

--Soredia: Bursting, grainy soredia from labriform (lip-shaped) upturned thallus margins[49]

--Apothecia: Rare, red-brown and funnel-shaped

--Distinctive Features: Puffy (hollow) upturned lobes[48] rip open and soredia burst forth from underside, forming lip-like soralia. Lobe tips lacking soredia are often brown[50]. Thallus upper surface is gray to gray-green with brown to black undersurface that lacks rhizines.

--Notes: The lip-like soralia separate this lichen from the other puffy foliose lichens lacking rhizines (*Menegazzia terebrata*, tree flute lichen and *Hypogymnia tubulosa*, powder-headed tube lichen).


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50

Salted Shield Lichen (*Parmelia saxatilis*)

--Habitat: Rock outcrops, exposed or shaded, and woods, especially higher elevations (e.g., Spruce Knob)

--Substrate: Rock (typically) or bark

--Isidia: On surface of lobes, cylindrical or flattened in shape, often brown-tipped

--Soredia: None

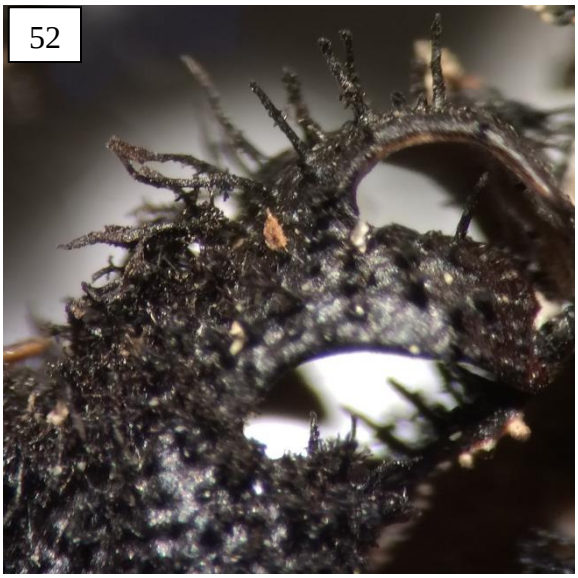
--Apothecia: Infrequent, with isidia on disc margins

--Rhizines: Black, simple[52] to forked, sometimes forming a thick mat in older thallus

--Distinctive Features: Thallus upper surface somewhat resembles hammered steel, with a shiny dented surface and a network of white cracks (pseudocyphellae)[51]. Color above varies from gray to gray-green to brown (in exposed habitats) or with brown lobe tips; color below is black[52].

--Notes: *Parmelia saxatilis* is also known as crottle and was used as a traditional clothing dye in Scotland (Fraser 1983). *P. squarrosa* has squarrosely branched rhizines and is more common at lower elevations (Flenniken 2008).

51



52

Common Dog Lichen (*Peltigera canina*)

--Habitat: Shady woods

--Substrate: Mossy soil

--Isidia & Soredia: None

--Apothecia: Common, reddish-brown, saddle-shaped; borne on upturned thallus lobes that resemble dog canines[53]

--Rhizines: Pale, tufted and richly branched[55]

--Distinctive Features: Thallus above has wide lobes that are grayish-brown (when dry)[54] and downy (tomentose) at margins or overall. A stratified cyanolichen, it is dark bluish-gray above when wet. Thallus below is white, with bundles of white rhizines and white to brownish upraised veins. With no lower skin (cortex), the thallus is difficult to separate from moss and soil.

--Notes: Upright tooth-like lobes bearing apothecia are diagnostic for *Peltigera*, although *P. horizontalis* has circular apothecia on only slightly upturned lobes and a shiny thallus. *Peltigera rufescens* has upright apothecia-bearing lobes but is heavily tomentose. *Peltigera* has 11 species in WV, differing with regard to color, tomentum, isidia, soredia, and rhizines. The tomentum and shaving-brush like rhizine bundles help diagnose *P. canina.*


53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55

Many-fruited Dog Lichen (*Peltigera polydactylon*)

--Habitat: Mossy areas in forested, sheltered habitat

--Substrate: Rock, mossy soil

--Isidia & Soredia: None

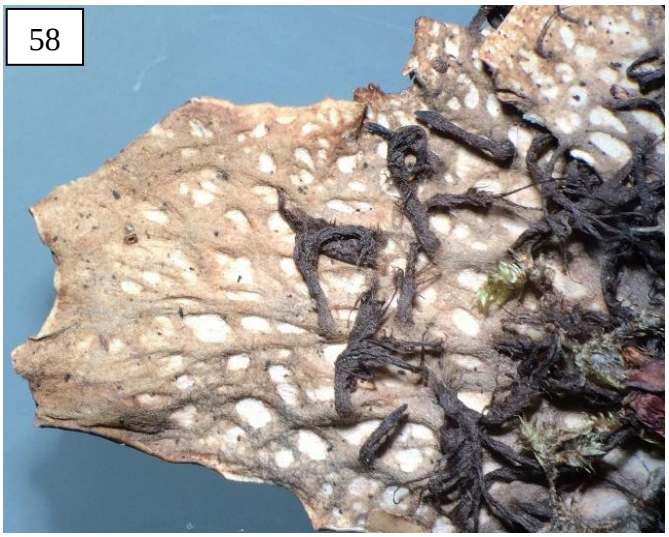
--Apothecia: Saddle-shaped on erect, recurved finger-like projections of lobe tips[57]

--Rhizines: Scattered and sparse, simple to packaged in bundles[58]

--Distinctive Features: Large gray to brown cyanolichen (bluish gray-green when wet and alive; lower left image), shiny thallus[56] that is not fuzzy (tomentose) and ranges greatly in size. Lower surface buff colored with broad, dark, raised veins and bright white ovals in between veins[57]. Apothecia on erect, finger like projections may remind you of cattails.

--Notes: The finger-like apothecia-bearing lobes and bright white ovals below help distinguish *P. polydactylon* from other shiny dog lichens with blue-green (cyanobacteria) photobionts. West Virginia has one dog lichen (*Peltigera leucophlebia)* with a green photobiont and it is the only bright-green dog lichen in the state, apparently uncommon.

Photo credit: Susan Studlar, September 2017 (Pennsylvania)



Smooth Lungwort (*Lobaria quercizans*)

--Habitat: Shady, deciduous woods

--Substrate: Bark, preferring sugar maple (Brodo et al. 2001)

--Isidia & Soredia: None

--Apothecia: Abundant, discs red brown, rim color of thallus; wart-like when young[59]

--Rhizines: Scattered rhizines within downy tomentum

--Distinctive Features: Bluish-gray-green thallus (when wet and alive), smooth to wrinkled above, with rounded lobe tips suggestive of white oak leaves[59, 60]. Striking red-brown apothecia contrast with blue-green thallus. Undersurface pale brown and tomentose and scattered rhizines.

--Notes: The other two WV lungworts (*L. pulmonaria* and *L. ravenelii*) have bare spots in the tomentum on the undersurface. Also, *L. pulmonaria* has a network of depressions above (reticulate). *Lobaria quercizans*, like *L. pulmonaria*, is considered an old-growth indicator. Menomini people of Wisconsin used *L. quercizans* as food and medicine.

Photo credit: Susan Studlar, November 2011 (Canaan Valley SRP)

Star Rosette Lichen (*Physcia stellaris*)

--Habitat: Deciduous trees in open woods and roadsides

--Substrate: Tree bark

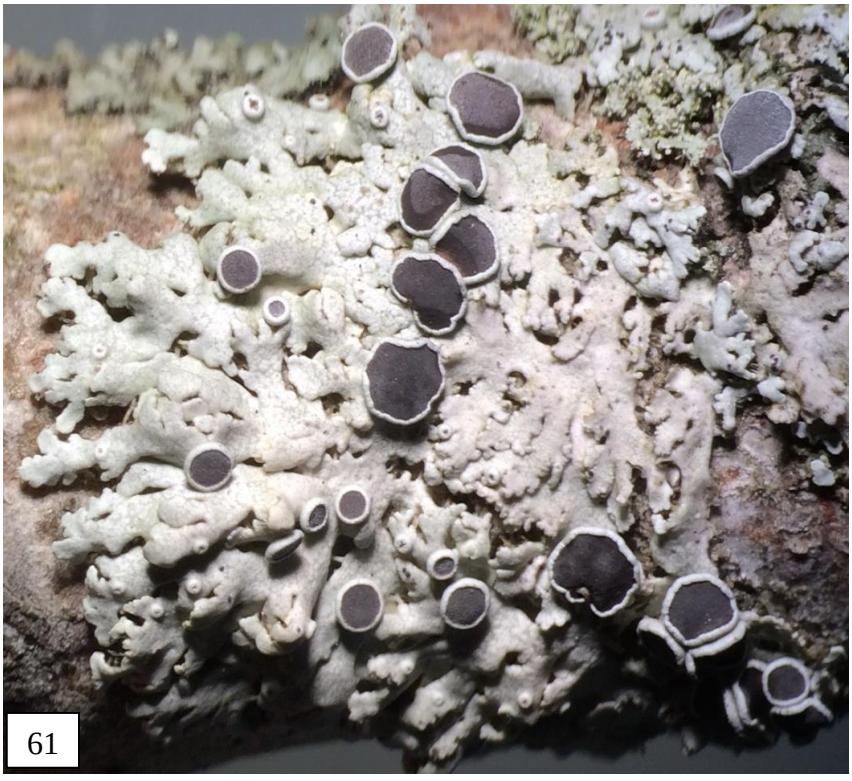
--Soredia and Isidia: None

--Apothecia: Abundant dark brown disks are lightly sprinkled with white powdery crystals (calcium oxalate, which also gives rhubarb its tart flavor)[62]

--Rhizines: Pale to dark

--Distinctive Features: *Physcia's* are small foliose lichens that grow out in all directions (star-like) forming compact circular colonies[61] - thus called "rosette lichens." Typically they are gray above and pale below. *P. stellaris* has linear often convex lobes (about 2 mm wide) with rounded tips. The thallus is smooth to wrinkled (especially in the colony center) with a few white spots (maculae). It is similar to the more heavily pruinose and white-spotted, chemically distinct *P. aipolia.*

--Notes: *P. stellaris* is one of the most common rosette lichens on hardwoods. However, there are over 30 species of *Physcia* in North America (over 10 in WV), mostly requiring chemical and microscopic tests for diagnosis.



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62

Common Greenshield Lichen (*Flavoparmelia caperata*)

--Habitat: Open woods and roadsides

--Substrate: Bark, sometimes old wood, less often on rock

--Isidia: None

--Soredia: Grainy[64] and scattered throughout lichen, very variable

--Apothecia: Rare

--Rhizines: Black and simple

--Distinctive Features: Dull yellow-green smooth to wrinkled (especially in center) thallus with scattered granular soredia[63]. Lobes flat, broad and rounded. Undersurface black and rhizinate but with brown rhizine-free margins[65]. May form large circular colonies on trees. Texture may remind you of chewed bubble gum.

--Notes: Probably the most common lichen you will encounter in WV. The older middle portion of the thallus may decay and fall out, leaving a lichen "doughnut." *Flavoparmelia baltimorensis* grows only on rock, and has dome-like pustular isidia. *Punctelia* is bluish-gray and sprinkled with small white dots (pseudocyphellae).

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65

Rock Greenshield Lichen (*Flavoparmelia baltimorensis*)

--Habitat: Shady or sunny woods

--Substrate: Almost exclusively on siliceous rock

--Isidia: Knobby outgrowths (pustules) toward center of thallus are either regarded as coarse isidia or as granular thallus fragments known as schizidia[67].

--Soredia: Lacks true soredia

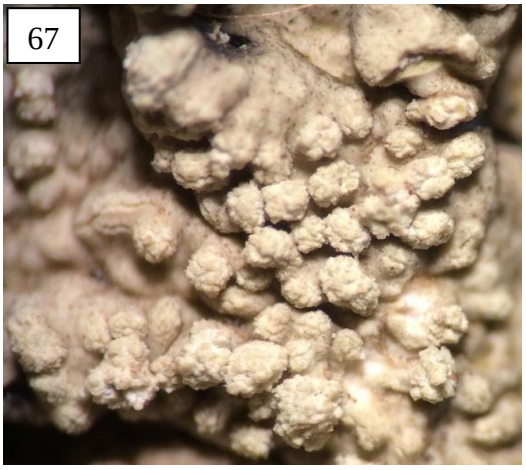
--Apothecia: None to rare

--Rhizines: Simple, short, black, and sparse[68]. Not present at lobe margins[68].

--Distinctive Features: Rock Greenshield can be recognized by its pale-green, broad-lobed thalli that are wrinkled in the center and look warty or knobby due to coarse "isidia"[66]. It resembles Common Greenshield (*F. caperata*): both species are pale above and black below with brown rhizine-free borders. However, Rock Greenshield grows on rocks whereas Common Greenshield is usually on trees.

--Notes: Only two species of *Flavoparmelia* are found in West Virginia but substrate (rock) and asexual propagules (coarse isidia) will usually distinguish *F. baltimorensis* from *F. caperata.* "Flavoparmelia" means "Yellow Shield," referring to the yellow usnic acid, an antibiotic that contributes to the lichens yellow-green color.


66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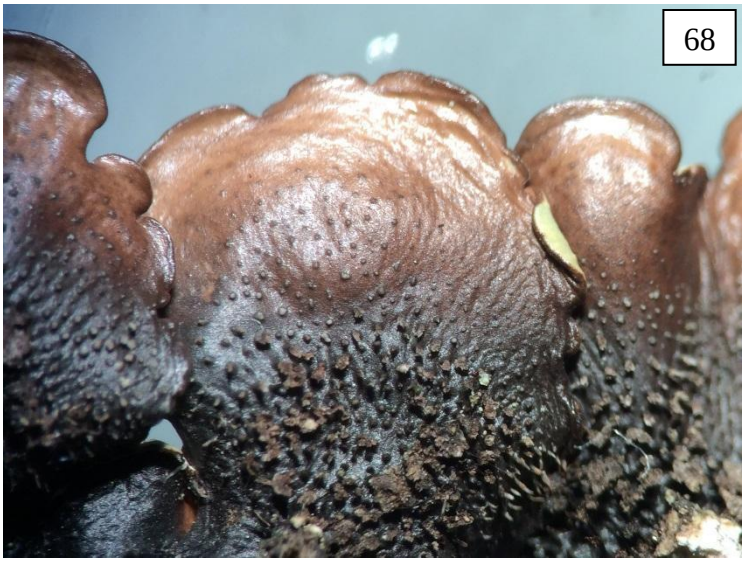
68

Rough camouflage lichen (*Melanohalea exasperata, syn. Melanelia exasperata)*

--Habitat: Open woods and roadsides, often overlooked (hiding in plain sight!)

--Substrate: Tree bark

--Isidia & Soredia: None

--Apothecia: Common and warty, with warty rims[70]

--Rhizines: Simple, black, abundant, extend to thallus margins

--Distinctive Features: Olive-brown to chestnut brown warty thallus often blends in with the tree bark[69]. Warts typically have white pores (pseudocyphellae) at their tops, resembling tiny volcanoes. The warts do not readily break off readily and are thus not true isidia. White-tipped warts, lack of isidia and soredia, and non-response to chemical spot tests will distinguish this species from similar brown camouflage lichens on bark in the genera *Melanelia, Melanohalea,* and *Melanelixia.*

--Notes: Camouflage lichens tend to more abundant at higher elevations and in boreal regions. The species name means "rough brown lichen."

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Powdered Ruffle Lichen (*Parmotrema hypotropum*)

--Habitat: Open woods, roadsides

--Substrate: Bark of tree branches and trunks

--Isidia: None

--Soredia: Abundant clumps on the "ruffled" lobe margins[72]

--Apothecia: Uncommon, disc brown

--Rhizines: Simple, black; not present at lobe margins[73]

--Distinctive Features: Large, broad, rounded, greenish-gray lobes show ruffled margins with marginal cilia abundant[71, 72]. Thallus upper surface often displays white spots (maculae) but not pseudocyphellae (breaks in cortex that expose medulla). Black undersurface shows blotches of brown and ivory white near margins, with margins rhizine-free[73].

--Notes: *Parmelia hypotropum* somewhat resembles *Punctelia rudecta* in field but has marginal soredia and cilia, and no pseudocyphellae. There are twelve recognized species of *Parmotrema* in WV, distinguished by soredia, isidia, cilia, and chemical spot testing. *Parmotrema hypotropum* can be used to dye wool brown.

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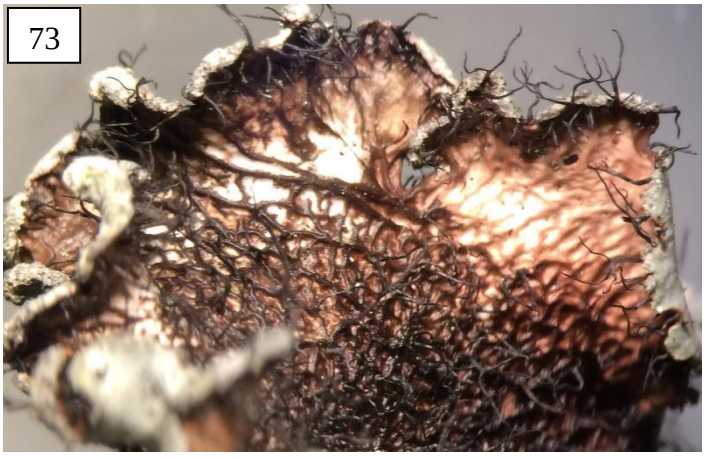


Perforated Ruffle Lichen (*Parmotrema perforatum*)

--Habitat: Sunny, open sites

--Substrate: Bark of upper branches and trunks

--Isidia & Soredia: None

--Apothecia: Common, stalked, large and almost bowl-like, with a hole in the center of the brown disk[74]. Perforated disks may remind you of eyeballs[74].

--Rhizines: Simple, black or brown, with a rhizine-free marginal zone

--Distinctive Features: Mineral gray thallus with broad, rounded lobes and black marginal cilia[74]. Perforated apothecia are striking. Lower surface is splotched with white near margins, and becomes dark brown or black near the center.

--Notes: In WV, *P. perforatum* is evidently much less common than *P. hypotropum*.

Photo credit: Susan Studlar, June 2011 (North Carolina)

Lemon Lichen, Candleflame Lichen (*Candelaria concolor*)

--Habitat: Open woods

--Substrate: Bark of deciduous trees, sometimes on rocks

--Isidia: None

--Soredia: Abundant, yellow, aggregated into granules[77], marginal[76] or covering the whole thallus

--Apothecia: Rare. Disks are yellow, with rims that match the thallus in color (thus "concolor"); disk centers may be deeper yellow to orange[77].

--Rhizines: Sparse, white, and unbranched

--Distinctive Features: This tiny foliose yellow lichen[75] can be distinguished from yellow crustose lichens (such as *Candelariella*) by finely divided lobes[76], abundant yellow soredia and sparse white rhizines. Colonies may fuse into a yellow powdery mass on the rain tracks of trees.

--Notes: Lemon Lichen thrives on trees and rocks that are nitrogen-enriched (eutrophic) by the droppings of perching birds.


75


76


77

Hammered Shield Lichen (*Parmelia sulcata*)

--Habitat: Open woodlands, roadsides

--Substrate: Usually on tree bark, also on old wood and rocks

--Isidia: None

--Soredia: Develop at cracks in thallus and ridges of upper cortex

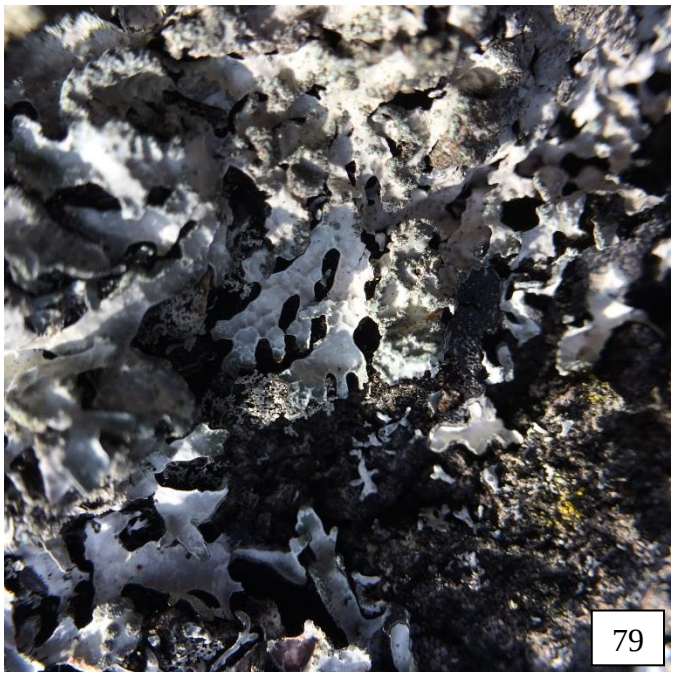
--Apothecia: Rare, discs are dark brown

--Rhizines: Dense, squarrosely (right angled) branching, simple at margins

--Distinctive Features: Thallus grayish-bluish green with hammered texture (network of ridges and depressions), and a corresponding network of pseudocyphellae (cracks exposing white medulla)[78, 79]. Thallus lobes narrow and divergent, often with arched lobe tips. Lower surface black.

--Notes: *Parmelia sulcata* is evidently pollution tolerant, being found commonly in all WV counties and urban areas throughout North America. *Parmelia saxatilis* also looks hammered but is isidiate, lacks the linear white network, and usually grows on rock rather than bark.

78



79

Mealy Rosette Lichen (*Physcia millegrana*)

--Habitat: Any open forest or woodland, roadsides, urban

Substrate: Tree bark

--Isidia: None

--Soredia: Heavy (thus "mealy"), lobe tips and edges

--Apothecia: Often absent, but many if present. Disks powdery (pruinose) and dark brown[81].

--Rhizines: Sparse, pale to light brown

--Distinctive Features: The small and dull gray-white thallus lobes are covered in flecked, crumbly soredia, and the lobes overlap each other with lobe tips finely cut[80]. *Physcia millegrana* can grows in large mats even though a small lichen[82].

--Notes: *Physcia millegrana* is frequently the first to colonize young woody plants, but it is also found rarely on rock. This species can be considered a habitat generalist and is tolerant of air pollution.

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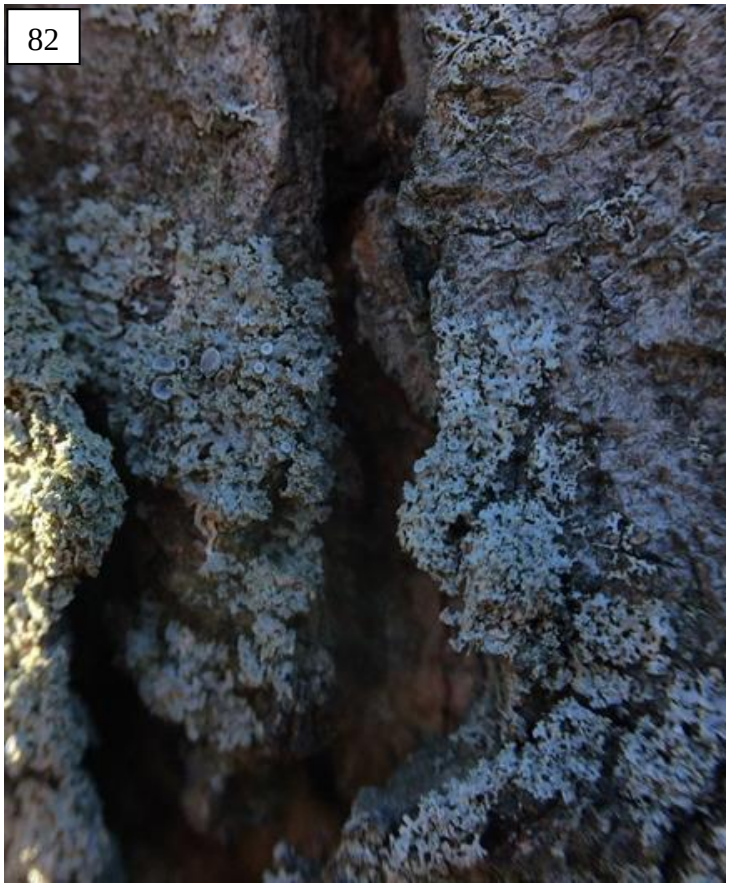


Powdered Speckled Shield Lichen (*Punctelia caseana*)

--Habitat: Open woods, roadsides

--Substrate: Bark

--Isidia: None

--Soredia: Powdery, scattered and bursting along lobe margins and surface but not lobe tips[84]

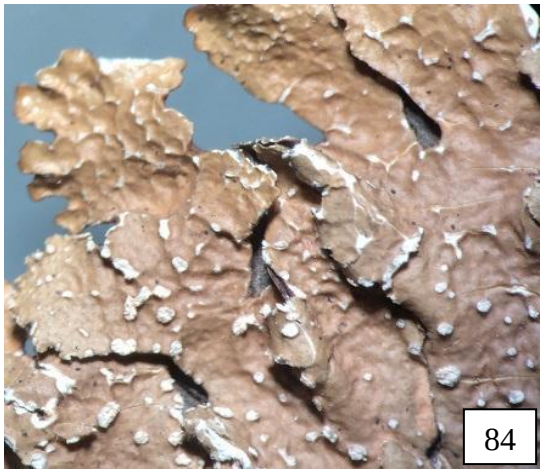
--Apothecia: Rare, reddish-brown discs

--Rhizines: Simple and very short, pale to dark brown and approaching margins[85]

--Distinctive Features: Large rounded slightly mineral gray-green lobes[83]. Thallus smooth to weakly ridged and speckled; has small pores (pseudocyphellae) where the white medulla becomes exposed. Soredia are powdery and often aggregated into granular soralia along margins. Lower surface is tan to white.

--Notes: Previous records of *P. subrudecta* are now considered to be *P. caseana* and other species; *P. subrudecta* does not occur in North America (Lendemer & Hodkinson 2010*).* *Punctelia* means dotted, referring to pseudocyphellae on upper surface. *Punctelia rudecta* looks similar to *P. caseana* but is isidiate rather than sorediate.


83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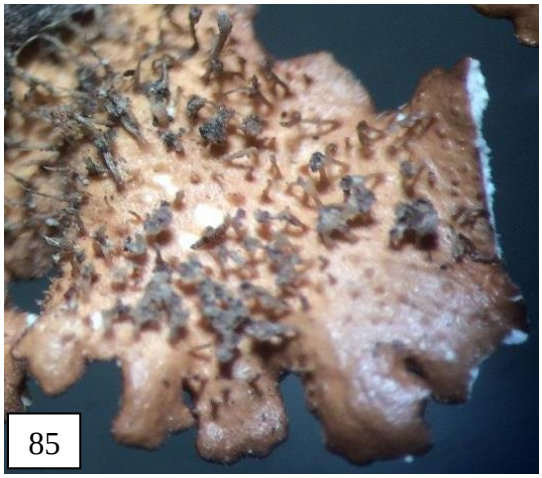

85

Rough Speckled Shield Lichen (*Punctelia rudecta*)

--Habitat: Open woods, roadsides

--Substrate: Bark, rocks

--Isidia: Common, cylindrical, occasionally branched, dense toward the center, sparse toward lobe edges[87]. Isidia can be very abundant!

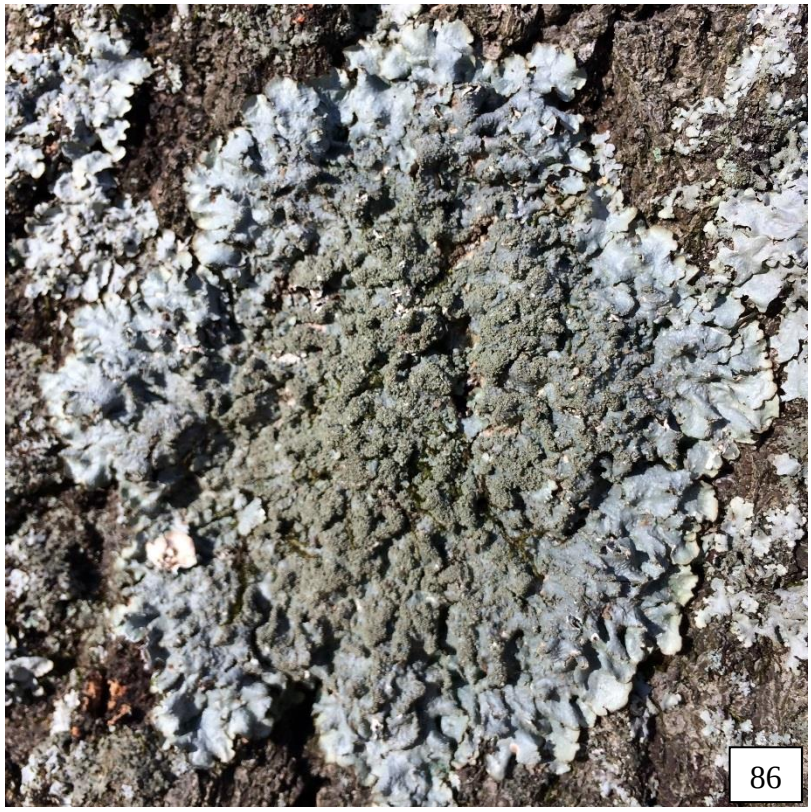
--Soredia: None

--Apothecia: Uncommon, brown discs[88]

--Rhizines: Pale to light brown, simple, throughout lower surface to lobe margins

--Distinctive Features: Bluish-Greenish-gray thallus speckled with distinct white dots (pseudocyphellae), especially the tips[86]. Isidia conspicuous, either simple (flattened) or branched and most dense toward center of thallus[86]. Lower thallus pale to tan.

--Notes: Although the two most common Punctelia species (*P. rudecta* and *P. caseana*) are pale to tan below, two WV species (P. *appalachensis* and *P. punctilla)* are black below.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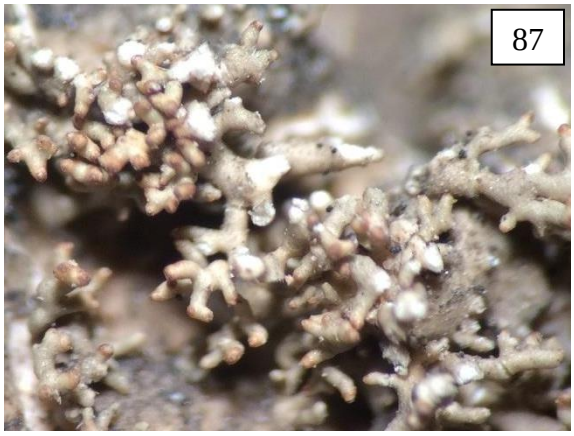
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88

Burred Horsehair Lichen (*Bryoria furcellata* syn. *Alectoria nidulifera*)

--Habitat: Open coniferous forests at high elevations

--Substrate: Usually on bark of conifers, less often on old wood, occasional on soil among blueberries

--Isidia: Brown to black spiny isidia protrude from white patches of soredia, although young isidia look like black bumps[90]

--Soredia: Numerous white powdery clumps of soredia burst out from the dark thallus[90]

--Apothecia: Generally absent

--Distinctive Features: The spiny dark isidia arising from white soredia make this species easy to distinguish from the only other *Bryoria* species in WV: *B. trichodes* (Horsehair Lichen), which lacks soredia and isidia. The conspicuous spiky soredia patches (reminiscent of a bad case of chicken pox)[89, 90] provide abundant asexual propagules for the lichen.

--Notes: *Bryoria* species, often called Horsehair Lichens, are bushy, brown, hollow lichens that provide important winter forage for deer and elk in northern coniferous forests. Also they are a traditional source of yellow dyes.


89


90

Common Antler Lichen (*Pseudevernia consocians*)

--Habitat: High elevation forest, coniferous forest

--Substrate: Bark of tree branches and trunks

--Isidia: Moderate to abundant little cortex hotdogs[93] growing over the antler-like thallus

--Soredia: None

--Apothecia: Not seen

--Distinctive Features: Highly branched, mineral-gray thallus somewhat resembles a reindeer lichen (*Cladonia*), but branches (lobes) are flattened, with black and white mottled color on the grooved (canaliculate) underside[92]. Upper surface displays abundant, sometimes branched isidia. The regularly (to irregularly) forked branches may remind you of caricatures of antlered animals[91]. Like *Cetraria arenaria* it is considered to be fruticose (shrubby) but has distinctly different upper and lower surfaces, as typical for foliose lichens.

--Notes: The other *Pseudevernia* species in WV is *P. cladonia*, which lacks isidia. *Pseudevernia* means false *Evernia. Evernia mesomorpha* is somewhat similar to *Pseudevernia,* but is yellow-green, flexible, and flabby. Both *Pseudevernia* and *Evernia* species are used in the perfume industry.


91

Photo credit: Susan Studlar, May 2011 (Cathedral SP)


92


93

Gray Reindeer Lichen (*Cladonia rangiferina* syn. *Cladina rangeriferina*)

--Habitat: Open or shaded areas at higher elevations (e.g., Dolly Sods)

--Substrate: Soil, often with moss

--Isidia & Soredia: None

--Apothecia: Uncommon, on the tips of branches (brown and inconspicuous)[96]

--Distinctive Features: Multi-branched white to silver-gray stalks (podetia) with branch tips that typically face same direction as if combed with a brush, or like mini hands grabbing something[94]. Ultimate branchlets are commonly in three's, four's (two groups of two) or two's (dichotomous forking). Upper thallus lacks a cortex, and looks cottony. Stalks (podetia) somewhat resemble dried nautical ropes[95]. Base of podetia pale and same uniform color as the rest of branch.

--Notes: As the name implies, reindeer lichens are an important food (especially in winter) for caribou populations (Bergerud 1972). Reindeer lichens are all hollow (like all *Cladonia* species) and bushy. *Cladonia rangiferina* differs from the other four WV reindeer lichens by being steel-gray to the base and "wind-blown", with ultimate branchlets mainly in 4's (two groups of 2).


94


95


96

Dixie Reindeer Lichen (*Cladonia subtenuis* syn. *Cladina tenuis*)

--Habitat: Open woods, roadsides

--Substrate: Soil, often among moss

--Isidia & Soredia: None

--Apothecia: Brownish red pycnidia (flask-like reproductive structures with mouths of flasks showing up as dots on the lichen thallus)[98], or apothecia at the end of ultimate branchlets[97]

--Distinctive Features: Bushy, with slender pale yellow-green to greenish gray stalks that show "Y" dichotomous (forking) branching and may be terminated with small brownish-red apothecia and pycnidia[97]. Branches face in various directions (rather than appearing wind-blown as in *C. rangiferina*)[97]. Podetial surface smooth and axils mostly closed (no holes).

--Notes: *Cladonia subtenuis* is widespread in WV, and it is the reindeer lichen you will most likely encounter. Yellow green color and branchlets growing in various directions help distinguish it from *C. rangiferina.*

97

98

Star-tipped Reindeer Lichen (*Cladonia stellaris* syn. *Cladina stellaris*)

--Habitat: At higher elevations in WV (e.g., Spruce Knob) in open areas or in open woods

--Substrate: Sandy soil, humus

--Isidia & Soredia: None

--Apothecia: Uncommon, at tips of branches, reddish-brown. Pycnidia are reddish-brown[100].

--Distinctive Features: Grows in clumped yellow-green rounded mounds that suggest cauliflower that escaped the kitchen and went feral[99]. Branching is dense and dichotomous; short branches repeatedly rebranch, usually without one main stalk[100]. Ultimate branchlets are typically in 4's (two groups of 2) and groups of branches may surround an *open axil* (hole in the axil of a lower branch)[101]. A cortex is lacking and the cottony medulla and can be seen.

--Notes: WV has five reindeer lichens, but this is the only one growing in compact yellow-green mounds, quite distinct even from a distance. This is the favorite food lichen for caribou, preferred over *C. rangiferina*. It is also used in arts and crafts and for the extraction of usnic acid (used as an antibiotic).


99


100


101

Sinewed Strap Lichen (*Ramalina americana*)

--Habitat: Open woods and roadsides in mountain counties of WV (southern and eastern WV)

--Substrate: Bark of trunks, branches and twigs

--Isidia & Soredia: None

--Apothecia: Common, on margins near ends of lobes or on lobe tips, color pinkish to creamy to yellowish (due to pruina)[100]

--Distinctive Features: Grows as an abundantly branched yellow-green tuft with mostly flattened, sinewy branches that are narrow to broad[100]. Thallus smooth to ridged (striate) with white stripes (pseudocyphellae) often present. Flattened thallus may remind you of a chewed-up leather dog toy. In live specimens, upper and lower surfaces are distinct, as in foliose lichens, but rhizines are lacking.

--Notes: *Ramalina* has 6 species in WV. Only *R. americanum* and *R. culbersoniarum* are non-sorediate; they can be distinguished only by chemical tests (thin-layer chromatography or TLC).

Photo credit: Susan Studlar, June 2011 (North Carolina)

Bristly Beard Lichen (*Usnea hirta*)

--Habitat: Open woods at higher elevations in WV

--Substrate: Conifer and hardwood trunks, branches, and canopy twigs; old weathered wood (e.g., fence posts)

--Isidia: Lacking, but has abundant isidia-like spiny fibrils[102]

--Soredia: Absent or sparse

--Distinctive Features: Greenish-yellow thallus is tufted and spiny, resembling a bristly beard[101]. Attached to the substrate by a pale to brownish (but not black) basal holdfast. Branches are usually ridged and angular (rather than round in cross-section), and are cloaked with spine-like fibrils that look similar to isidia[102]. The cord within the branches and fibrils is white, as is the medulla.

--Notes: All *Usnea* species have a dense internal cord surrounded by medulla and cortex (*Usnea* means rope-like). If you hold a branch between thumb and forefinger and strip off the softer outer tissues, you can see this unique cord that gives the lichen support. WV has 14 *Usnea* species, some growing as small tufts and others as long beards, but this is the only tufted *Usnea* completely cloaked in spiny fibrils and generally lacking soredia.


101


102

Bushy Beard Lichen (*Usnea strigosa*)

--Habitat: Open woods, roadsides, especially in higher elevations in WV

--Substrate: Deciduous tree trunks, branches, and canopy twigs

--Isidia & Soredia: None

--Apothecia: Common, with large round yellow-green (to orangish or tan) disks at the ends of branches[105]. Fibrils radiate from all sides of each disk, perhaps reminding you of a Venus fly trap.

--Distinctive Features: Very bristly tufts with large bristly apothecia (and no soredia or isidia) make this an easy species to recognize in the field. The cortex is yellow-green[104], but the medulla and central cord can be either red or white.

--Notes: The bristly branches of *U. strigosa* could remind you of a bottlebrush or even a caterpillar[106]. In a remarkable example of lichen mimicry, the caterpillar of an uncommon moth feeds upon *U. strigosa* and probably deters predators by its near-perfect resemblance to this mildly toxic lichen rich in usnic acid (Sigal 1984).

Photo credit: Susan Studlar, January 2018 (North Carolina)

Mealy Pixie Cup (*Cladonia chlorophaea* complex)

--Habitat: Open woods and disturbed areas

--Substrate: Acidic mineral soil, rocks, rotting logs, and tree bases, often among mosses

--Isidia: None

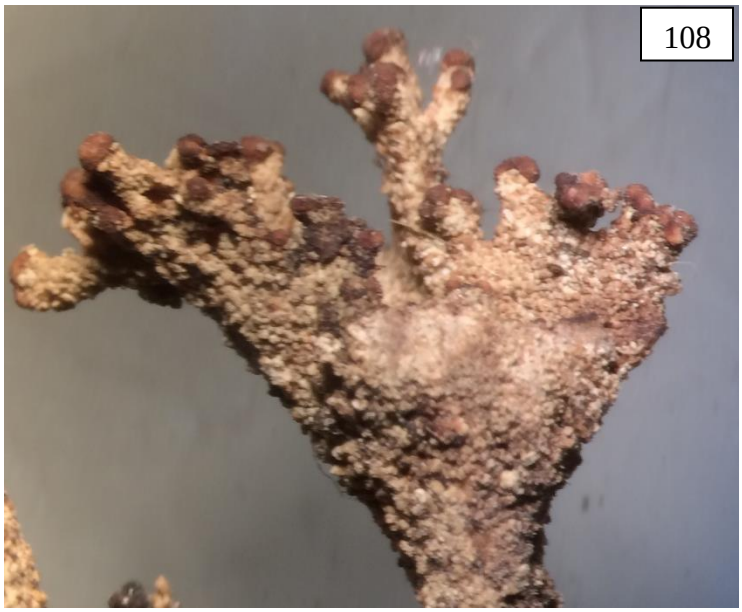
--Soredia: Powdery and granular soredia form a dusty cover over both the podetia and the outsides and insides of the cups

--Apothecia: Small brown knob-like apothecia often develop on stalks often proliferate from cup edges[108]

--Distinctive Features: The "pixie cups" of this species look like wine glasses sprinkled with greenish granular "flour" (soredia)[107]. Pebbled Pixie Cup (*Cladonia pyxidata)* looks very similar but has tiny flakes (areoles or squamules) in the cup rather than soredia (although old Mealy Pixie Cups may have a few areoles). Trumpet Lichen (*Cladonia fimbriata)* has podetia and cups that are narrower (resembling golf tees) and dusted with fine powdery soredia.

--Notes: Pixie cups evoke images of fairy wine glasses, but they actually collect water that disperses sexual propagules of the fungus (spores) and asexual propagules of the lichen (soredia); hence they are rain-powered "splash cups." Stalked splash cups develop from small flakes (squamules) that may disappear with time. Several related species (such as *Cladonia grayii)* with very similar cups can only be distinguished with chemical tests.

Photo credit: Susan Studlar, October 2013
(Canaan Valley SRP)



Powderhorn Lichen (*Cladonia coniocraea*)

--Habitat: Shaded woods

--Substrate: Rotting logs and stumps, tree bases, and soil, often among mosses

--Isidia: None

--Soredia: Soredia extend in indistinct patches almost to base of podetium. Squamules are also sometimes sorediate[110].

--Apothecia: Rare, brown, and at podetia tips; with either no cups or very narrow cups no wider than the podetia.

--Distinctive Features: Podetia arise from the centers of relatively large, bright green, lobed squamules (with bright white undersides that lack a cortex)[109]. Podetia are narrow and tapering, resembling awls, powderhorns, or witches' hats[111]. With skin (cortex) confined to very base (lower 1-2 mm), podetia have a balding look, with splotches of green and white, and powdery to granular soredia extending to the base.

--Notes: This is one of the most common lichens in the WV woods, but be on the lookout for the very similar *C. ochrochlora,* which typically has soredia on the upper half of the podetium only rather than throughout. However, intermediates occur!

109

Photo credit: Susan Studlar, December 2012 (West Virginia Botanic Garden)

110

British Soldier (*Cladonia cristatella*)

--Habitat: Open woods, roadsides

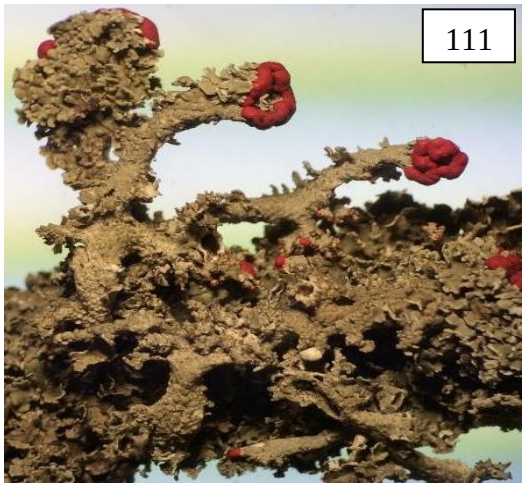
--Substrate: Soil, tree bases, rotting logs and stumps, decaying wood

--Isidia & Soredia: None (although the podetia can appear very bumpy)

--Apothecia: Bright red and lumpy (no cups) apothecia top branched podetia[113]. They may remind gardeners of red cockscomb (*Celosia cristata*).

--Distinctive Features: The upright lumpy podetia that lack soredia, and the bright red apothecia suggest British soldiers with spotless coats[111, 112]. The yellow-green podetia arise from persistent squamules that are also soredia-free.

--Notes: This is the cardinal of the lichen world, widely known as British Soldiers in its Eastern North American home (but there are no British soldiers in Britain!). Its colors are more subdued in shade. There are other somewhat similar *Cladonia* species that are sorediate. *Cladonia cristatella* was used in studies that helped to establish that the fungi-algae relationship is not always mutualistic but more of a controlled parasitism (Ahmadjian and Jacobs 1981).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113

Pebbly Pixie Cup (*Cladonia pyxidata*)

--Habitat: Open woods and disturbed areas

--Substrate: Acidic mineral soil, rocks, rotting logs, and tree bases, often among mosses

--Isidia & Soredia: None but small squamules in the cups can be confused with the granular soredia of *C. chlorophaea*

--Apothecia: Small brown and lump-like, apothecia may develop from short stalks on the edges of the goblet-shaped cups[115, 116]

--Distinctive Features: The grayish-green to brownish stalked cups (goblet-like) are filled with small squamules[115] can usually be distinguished from the mealy-granular cups of *C. chlorophaea*. The podetia also bears squamules (flakes), derived from breakup of cortex (skin). The primary squamules on the substrate (from which the goblets develop) are lobed, bright green above and white below (no cortex)[114]. The squamules (as is characteristic for *Cladonia*) lack rhizines and cortex, and are ascending (imagine green cornflakes standing on edge)[114].

--Notes: *Cladonia chlorophaea* complex and *Cladonia pyxidata* often grow inter-mixed and cannot always be reliably distinguished. Pixie cup lichens have captured the imagination of the public and are often featured in arts and crafts. Some have imagined tiny fairies sipping from the goblets unnoticed!


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116

Lipstick Powderhorn, Scarlet Pin Lichen (*Cladonia macilenta* var. *bacillaris* syn. *C. bacillaris*)

--Habitat: Open Deciduous forest

--Substrate: Rotting logs, stumps, tree bases, soil over rocks, often among mosses

--Isidia: None

--Soredia: Fine powdery soredia cloak podetia and often cloak squamules

--Apothecia: Often present, bright red and lumpy, on tips of branched or unbranched podetia

--Distinctive Features: Blunt or pointed, cupless stalks with bright red apothecia, suggesting pin heads or match heads[117]. Podetia are covered (mostly or all) with fine soredia and are lightly sprinkled with squamules. Squamules are grayish-green to brown above and white below (no cortex).

--Notes: *Cladonia macilenta*, with its bright red matchstick look and powdery stalks arising from powdery gray flakes can be distinguished with a hand-lens from other red *Cladonia's* that lack cups: *Cladonia cristatella* (no soredia) and *Cladonia floerkena* (granular soredia).

Photo credit: Susan Studlar (Blackwater Falls SP)

Red-fruited Pixie Cup (*Cladonia pleurota*)

--Habitat: Open woods, roadside banks

--Substrate: Rotting logs, stumps, tree bases, soil over rocks, often among mosses

--Isidia: None

--Soredia: Granular, cloaking the cups (inside and out) and also the upper portions of the podetia

--Apothecia: Bright red, on little extensions from the goblet rim (along with little red pycnidia)[119]

--Distinctive Features: Pale powdery yellow-green goblet-shaped cups are on short stalks that are powdery above and corticate below[118, 119]. Bright red stalked apothecia on goblet edges remind the first author (MF) of googly-eyed Krumm from *Aaahh!!! Real Monsters* (Nickelodeon)[120].

--Notes: This pixie cup lichen with red apothecia is easily distinguished from *C. chlorophaea*, which is similar but has brown apothecia.

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119

120

Script Lichen (*Graphis scripta*)

--Habitat: Somewhat shaded forests

--Substrate: Smooth-barked trees, such as birch, beech, and any young tree

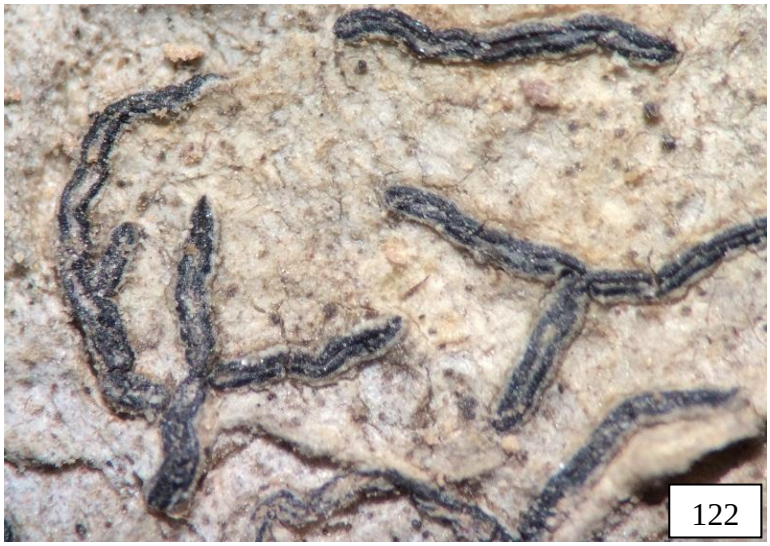
--Isidia & Soredia: None

--Apothecia: Elongate, raised, black squiggles called lirellae[122]. They can branch or be singular furrows.

--Distinctive Features: The thallus is embedded in the bark and barely visible as a dull creamy patch[121]. The furrows in the bark appear variable and erratic but may follow the lines (lenticels) in birch trees (Brodo et al. 2001). Resembles ancient scribbles or small black writings etched and embedded into the bark of a tree, perhaps written in a hurry.

--Notes: Other script lichens include asterisk lichen (*Arthronia*) and scribble lichen (*Opegrapha*), but this is the one you are most likely to encounter.

121



122

Powdery Gold Speck Lichen (*Candelariella efflorescens*)

--Habitat: Open woods

--Substrate: Bark of deciduous and coniferous trees

--Isidia: None

--Soredia: Abundant, yellow, marginal on "areoles" or comprising the entire thallus[124]

--Apothecia: Rare, with golden disk margins and deeper gold disk centers

--Distinctive Features: Thallus is made up of tiny bumps (areoles) that produce marginal soredia before breaking down completely into a continuous golden powder (sorediate crust) on tree trunks[123, 124]. The lack of lobes and rhizines distinguish *Candelariella* from *Candelaria,* and the bark substratum distinguishes it from the rock-dwelling *Caloplaca.*

--Notes: This is a nitrophilous, somewhat pollution tolerant species, similar to *Candelaria concolor* in its ecology; it thrives on tree bark enriched by bird droppings.

Dust Lichen (*Lepraria* spp.)

--Habitat: Humid shady sites, rocky overhangs, massive vertical cliffs (e.g., New River Gorge)

--Substrate: Rocks (especially siliceous sandstone), bark, wood, moss, and other lichens, depending on the species

--Isidia: None

--Soredia: The species shown is essentially nothing but soredia or aggregates of soredia[126]!

--Apothecia: None

--Distinctive Features: The dust-like (leprose) thallus[125] is a consortium of soredia that may be (in some species) aggregated into miniature fuzzy balls held together by mycelial filaments. You may be able to see the "cotton balls" with your hand-lens[126]. The thallus is blue-green to yellow-green to greenish gray depending on species, colored by the green photobiont and various lichen substances.

--Notes: Raindrops just bead up on the surface of *Lepraria* species (and other leprose lichens) since they cannot absorb liquid water. Therefore they derive virtually all their moisture from the air. *Lepraria* is among the minority of lichen genera that thrive in shaded, humid habitats. If you encounter a lichen that reminds you of cotton balls or cotton candy, drag your finger across it and see if you pick up dust (soredia) resembling powdered sugar. If so, it may be *Lepraria* (or a related genus). You can then serve as a vector for the dust lichen, like various animals, wind, and water (see "Fragments" in Introduction)!

The dust lichens (crustose-leprose lichens including *Lepraria*, *Chrysothrix*, and other genera) are under intensive study by James Lendemer and collaborators at the New York Botanic Garden, New classification schemes (based on chemistry and morphology) are being generated and new species are described.

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126

Bitter Wart Lichen (*Variolaria amara* syn. *Pertusaria amara*)

--Habitat: Shady woods

--Substrate: Bark of hardwoods, occasional on conifers or siliceous rock

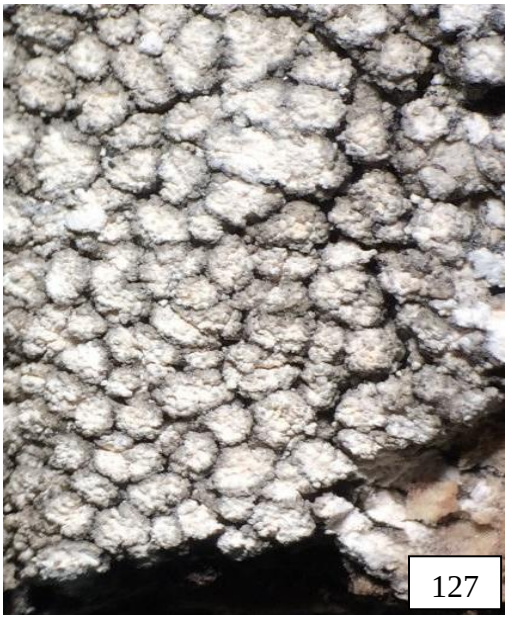
--Isidia: None

--Soredia: Abundant, clustering into wart-like mounds (soralia), that may run together with soredia spilling out onto thallus[129]

--Apothecia: Uncommon, hidden within soralia warts, readily disintegrating and usually sterile

--Distinctive Features: Mounds (warts) with bright white soredia[127]. Pale grayish-white to green-gray thallus, sometimes with white dots (pseudocyphellae) visible on darker thalli[128]. Thallus sometimes weak-margined, making it hard to tell where lichen ends and bark begins.

--Notes: The soredia have a really bitter taste but are not poisonous. Tasting a few soredia can help distinguish this lichen from other dirty white sterile sorediate crustose lichens. Not much information exists about the distribution and habitat of *V. amara* in WV, so it is worth documenting if you encounter it!


127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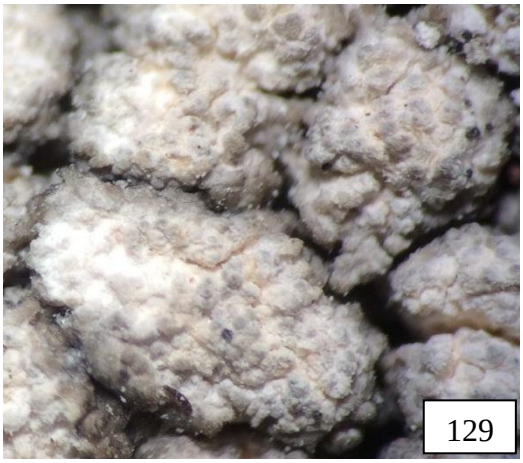
129

Lung Lichen (*Lobaria pulmonaria*)

--Habitat: Mature hardwood or hemlock-hardwood forests, often in shady mesic ravines

--Substrate: Bark of deciduous trees and logs

--Isidia: Occasional, arise among soredia

--Soredia: Abundant, forming cottony ribbons along the network of ridges on the upperside of the thallus, also found on lobe margins

--Apothecia: Infrequent, orange-reddish brown, near margins of lobes

--Distinctive Features: Thallus large and bright green when wet (paper bag brown to gray when dry), lobes often dichotomously branched (forking in two's) and squared off[131]. Upper surface of thallus with a conspicuous network of ridges (sorediate) and depressions (pits)[131]. Lower surface tan and downy (tomentose) with bumps that correspond to pits above[132].

--Notes: *Lobaria pulmonaria* is among the minority of lichens that have a green photobiont supplemented by blue-green cyanobacterial photobiont that is embedded in the lower thallus in globular *cephalodia.* Thanks to its cyanobacteria partner, lung lichen is a nitrogen fixer (pulling nitrogen from the air and putting it in the soil). Lung lichen is an old growth indicator, and can form beautiful bright green sheets, a gem among lichens. The only other lung lichen common in WV is *L.* quercizans, which lacks soredia. The pitted surface of *L. pulmonaria* is suggestive of lung tissue, and it was traditionally used to treat lung disease.


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Photo credit: Susan Studlar, 2016 (Blackwater Falls SP)

Red Beard Lichen (*Usnea rubicunda*, syn. *Usnea pensylvanica*)

--Habitat: Mature hardwood, hemlock-hardwood, and coniferous forests at higher elevations in WV

--Substrate: Bark of hardwoods and conifers

--Isidia: Isidiomorphs (isidia-like growths) few to numerous, usually arising from centers of soralia

--Soredia: Usually abundant on smaller branches and clustered into round soralia[134]. Soralia may remind you of lenticels on smooth-barked trees.

--Distinctive Features: Beard-like and tufted (erect) or drooping, with a single holdfast[133]. Branches cylindrical (not tapering), bearing few to many fibrils (spines that arise from branches) and abundant, warts or papillae (bumps)[132]. Thallus (tuft) reddish-orange throughout or mostly deep green or mottled green and red. Red pigment runs deep into the cortex, whereas medulla and central cord are white. Cortex interrupted with white soralia (sometimes with isidiomorphs) and occasional ring-like breaks.

--Notes: When red and powdery, the Red Beard Lichen is easy to spot on trees; when mainly dark green it could be confused with *U. hirta.* This is our only beard lichen that is red on the outside; other beard lichens (*U. mutabilis* and *U. strigosa)* may have red inside (medulla reddish).


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Dragon Cladonia (*Cladonia squamosa*)

--Habitat: Mature forest and open woods

--Substrate: Rotten logs, mossy rocks, soil

--Isidia & Soredia: None

--Apothecia: Uncommon, small, brown, at tips of podetia or on margins of cups[137]

--Distinctive Features: Podetia single to sparsely branched, sometimes ending in oblique, flaring cups[135]. Squamules are highly dissected and vary greatly in size, from micro-squamules to large squamules like those on the substrate (primary squamules, which may or may not persist). A prolific growth of squamules often covers virtually all the podetia, and cobwebby white medulla breaks through to the surface as podetial cortex (skin) disintegrates[136]. The abundant squamules, as individual as snowflakes, with podetia dimly visible beneath their "smothering" cover, may remind you of invasive kudzu swallowing up trees. Or the irregular scaly outline of the lichen may suggest a dragon. On the other hand, squamules have no lower protective and anchoring cortex. This is one way to get off the ground and into the sun!

--Notes: Dragon cladonia, a common lichen in our forests, slightly resembles *C. crispata*, which is much less squamulose and has much more intact skin (cortex). The absence of soredia helps distinguish Dragon Cladonia from other species with podetial squamules.

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Brook Lichen, Stream Stippleback (*Dermatocarpon luridum*)

--Habitat: Wet rocks of ledges, waterfalls, and waterline of pools

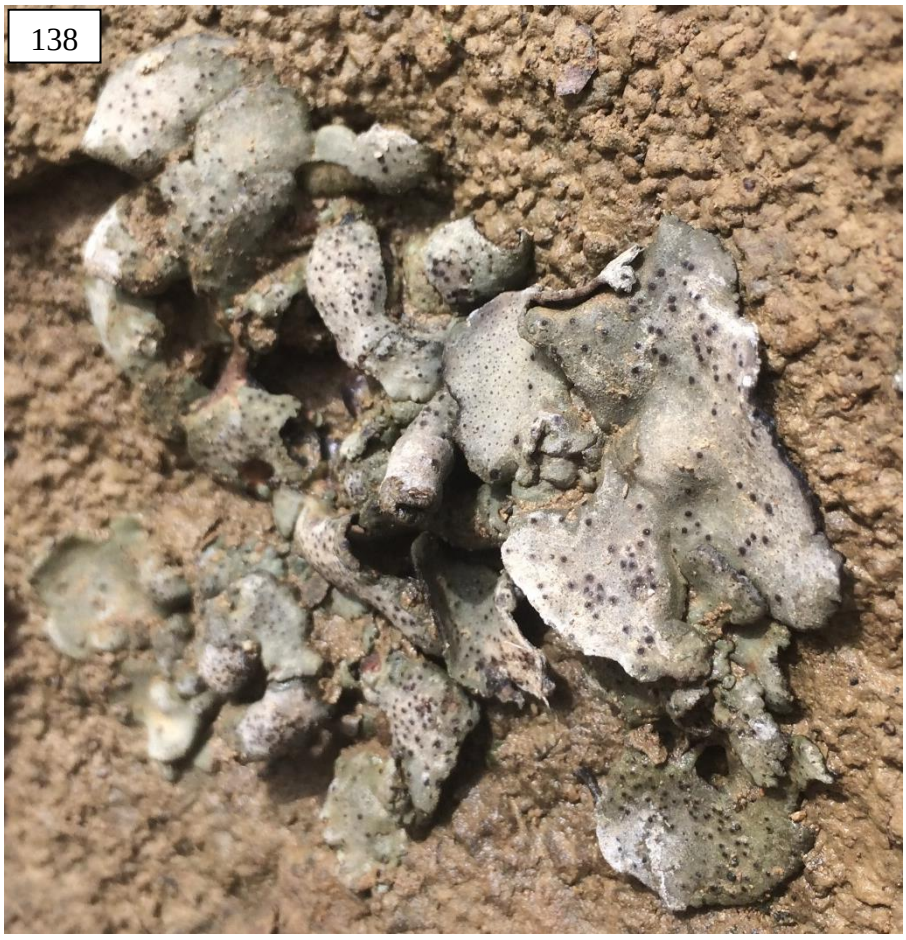
--Substrate: Rock

--Apothecia: Lacking; perithecia (sunken flasks releasing spores) abundant

--Isidia & Soredia: None

--Distinctive Features: Thallus made of overlapping lobes that are bright green above when wet and dull brown when dry[138, 139]. Undersurface is white to buff (brown) and has multiple holdfasts[140] but lacks rhizines. As each lobe may have several holdfasts[141], the thallus may resemble little webbed ears (or little rock tripes). Black perithecia are sprinkled over the thallus[138].

--Notes: The bright green (when wet) thalli of *D. luridum* are easily distinguished from other *Dermatocarpon* species. Among the few foliose lichens found in water, *D. luridum* somewhat resembles a thalloid liverwort, but scratch the surface to see the fungi below the photobiont layer.



Water Fan, Water Dog Lichen (*Peltigera hydrothyria* syn. *Peltigera venosa*)

--Habitat: Cold mountain streams near springs, at higher elevations. Not known from West Virginia.

--Substrate: Rock

--Isidia & Soredia: None

--Apothecia: Common, roundish, and reddish-brown (when wet)

--Distinctive Features: This is the only truly aquatic North American foliose lichen; requiring continual immersion in water. It is a gelatinous blue-gray to gray, ruffled, fan-shaped cyanolichen, with the blue-green *Nostoc* as its photobiont[141, 142]. Lower surface shows strong veins[141], as in other dog lichens (*Peltigera* species).

--Notes: If you find the Water Fan, formerly classified as *Hydrothyria venosa*, while wading in a cold mountain stream, please let the world know! WVU has no WV specimens while Duke University has 32 specimens from the Appalachians and Pacific Northwest, but none from WV.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Pink Earth Lichen (*Dibaeis baeomyces*)

--Habitat: Disturbed open areas

--Substrate: Soil (often clayish), on road banks, trail sides, and trampled areas

--Isidia & Soredia: None

--Apothecia: Small, pink and rounded, overtopping podetia[144]

--Distinctive Features: Thallus is crustose and whitish-gray with rounded white warts that may split into flat propagules (schizidia)[143]. From the whitish crust arise the podetia with pink apothecia, resembling small mushrooms. Podetia stalks are short and ribbed[144]. Growth-form is crustose-fruticose, a hybrid category. Fertile podetia may suggest tiny pieces of driftwood to which wads of pink bubblegum have been attached.

--Notes: *Dibaeis baeomyces* is easy to recognize as miniature pink mushrooms on a white warty crust, often forming large patches of Pink Earth. It also has the affectionate name of Fairy Puke.

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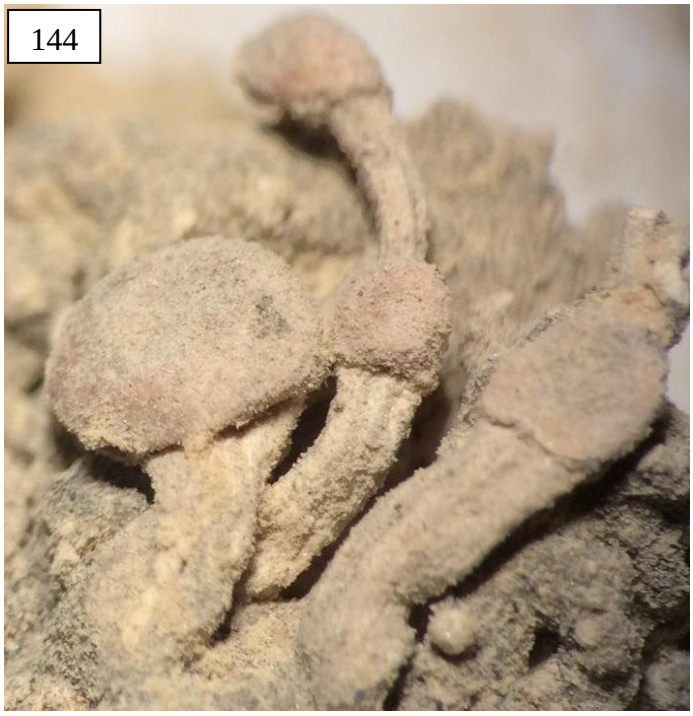

Photo credit: Susan Studlar, 2015 (Bear Rocks, Dolly Sods)

Nipple Lichen, Gnome Fingers (*Pycnothelia papillaria*)

--Habitat: Rock outcrops, disturbed areas, roadsides

Substrate: Sandy, gravely soil, or soil over rock

--Isidia & Soredia: None

--Apothecia: Uncommon, small, reddish-brown, at tips of stalks. What you typically see at the end of the stalks are brown or black dots that are openings to pycnidia (flask-shaped embedded fruiting bodies) rather than apothecia.

--Distinctive Features: Grayish-white primary thallus is granular (crustose)[145]. Secondary thallus (fruticose) arises from the primary thallus and is made up of short, hollow, irregularly inflated, white stalks (podetia) that are usually unbranched and taper to nipple-like brown tips dotted with pycnidia[145]. When densely clustered, the podetia (resembling gnome fingers) can hide the persistent primary crustose thallus. Growth-form is crustose-fruticose, a hybrid category.

--Notes: *Pycnothelia* has only one species in North America and is widespread in WV. Originally placed in *Cladonia* because of hollow stalks, the stubby puffy nipple lichen is easy to recognize.

Photo credit: Susan Studlar, 2010 (New River Gorge)

Turban Lichen (*Cladonia peziziformis*)

--Habitat: Old fields, road banks, open woods and mature forests

--Substrate: Bare soil banks, sometimes bark on logs and tree bases

--Isidia & Soredia: None

--Apothecia: Pale brown (light tan or caramel), lumpy, and spilling over tips of podetia[146]; no cups present.

--Distinctive Features: Podetia tall (up to 1 or 2 cm) and twisted, with ribs, grooves and minute warts (but no soredia)[146]. Cortex patchy (areolate) on stalks, which are somewhat translucent where cortex (skin) lacking. Podetia simple or sparsely branched with all branches bearing turban-like tan apothecia[146]. Squamules tiny and divided, almost crustose[147]. Podetia and squamules are grayish-green, deeper green when wet.

--Notes: *Cladonia peziziformis*, is distinctive, with its twisted soredia-free stalks, turban-like brown apothecia, and tiny squamules. *Cladonia cariosa* is somewhat similar but the brown apothecia are not swollen and turban-like.


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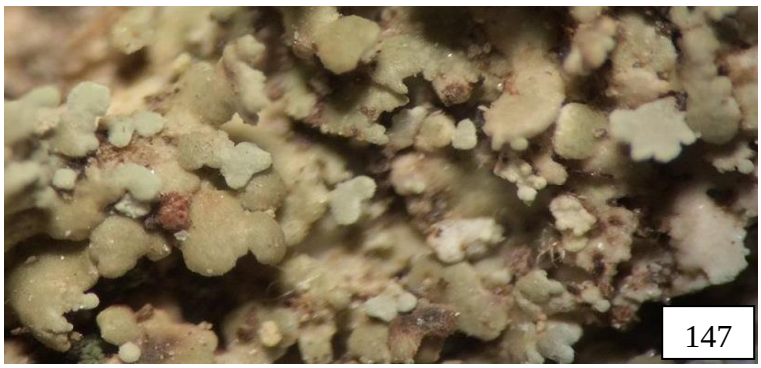
147

Soil Jelly Lichen (*Enchylium tenax* syn. *Collema tenax*)

--Habitat: Roadsides and open areas

--Substrate: Calcareous soil, among mosses

--Isidia: Globular isidia-like lobes may be present

--Soredia: None

--Apothecia: Reddish-orange brown disk with smooth to crenulate (slightly toothed) thalline rim[149]. Disks smooth or convex (when dry they may remind you of popcorn kernels)[149].

--Distinctive Features: Thallus dark-olive green and gelatinous when wet, black and almost membranous when dry[148]. Photobiont is the cyanobacterium *Nostoc*, and lichen is comprised of a mucilaginous jelly in which *Nostoc* filaments and fungal hyphae are interspersed. It is a non-stratified (no layers) cyanolichen. Neither upper nor lower skin (cortex) is present. Thallus lobes are minute, almost crustose. White rhizines anchor thallus lobes. Abundant red-brown apothecia contrast sharply with dark thallus[149].

--Notes: This is a nitrogen-fixing minutely foliose cyanolichen that is widespread on calcareous soils (much less common than siliceous soils in WV). Look along promising roadsides after a rain for a black jelly-like crust with orange disks.


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149

Photo credit: Susan Studlar, 2010 (Tennessee roadside)

Sidewalk Firedot Lichen (*Caloplaca feracissima*)

--Habitat: Sidewalks and stone walls of cities and towns; also limestone outcrops

--Substrate: Concrete, mortar, and limestone

--Isidia & Soredia: None

--Apothecia: Abundant, disks dark orange to brownish orange[151]

--Distinctive Features: Orange disks on sidewalks arise from a gray stain that represents the top of the mostly embedded thallus[150]. No rock-dwelling "firedots" (*Caloplaca*) species look just like this.

--Notes: Firedot lichens (*Caloplaca*) species are widespread rock-dwelling crustose lichens that almost always require microscopic examination to identify. Sidewalk Firedot is easy to recognize although it may be mistaken it for spilled orange paint!


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WEST VIRGINIA UNIVERSITY LICHEN HERBARIUM & VOUCHERS. West Virginia University (WVU) is home to the state's largest herbarium collection with over 185,000 plant specimens. There are 26,000 lichen and bryophytes in the collection. As part of a national effort to digitally catalog lichen specimens (NSF thematic collections network ADBC#1115116), 8220 WVU lichen vouchers can be found at the online Consortium of North American Lichen Herbaria (2017). Lichen vouchers are prepared for a university or personal lichen herbarium by drying lichens in a freezer for a few days in a brown paper bag, then storing dry in a 3x5 inch packet of folded paper with a detailed label on the outside of the packet. A specific date and location should be recorded for any specimen collected, along with the collector's name and any other pertinent information.

For this lichen guide, pictures were taken of specimens from the WVU lichen herbarium along with photos in the field whenever possible; we encourage readers to submit photos of representative in-field specimens for future guide updates. Which vouchers were evaluated are provided below unless no information was recorded at the time. An effort was made to use mostly vouchers from WV over other areas. Specific catalog number and other information found on vouchers used can be requested from the author. Additional sources that were consulted for species accounts are listed below with full citations in the Bibliography. All readers are encouraged to use the WVU lichen herbarium for study or to volunteer in current research efforts!

Smoky Eye Boulder Lichen (*Porpidia albo-caerulescens*)
References: Brodo (2016), Showman (2015)
Vouchers: Gray 1923

Burred Horsehair Lichen (*Bryoria furcellata* syn. *Alectoria nidulifera*)
References: Flenniken (1999), McMullin and Anderson (2014)
No voucher information recorded

Rock Greenshield Lichen (*Flavoparmelia baltimorensis*)
References: Brodo (2016), Flenniken (1999)
No voucher information recorded

Rough camouflage lichen (*Melanohalea exasperata***)**
References: Flenniken (1999), Whelan (2008)
No voucher information recorded

Sidewalk Firedot Lichen (*Caloplaca feracissima*)
References: Brodo (2016)
No voucher information recorded

Lemon Lichen, Candleflame Lichen (*Candelaria concolor*)
References: McMullin and Anderson (2014)
No voucher information recorded

Powdery Gold Speck Lichen (*Candelariella efflorescens*)
References: Brodo (2016), Westberg (2007)
No voucher information recorded

Sand-loving Iceland Lichen (*Cetraria arenaria*)
References: Brodo (2016) Flenniken (1999), McMullin and Anderson (2014)
No voucher information recorded

Mealy Pixie Cup (*Cladonia chlorophaea* complex)
References: Brodo (2016), Flenniken (1999), McMullin and Anderson (2014)
No voucher information recorded

Star Rosette Lichen (*Physcia stellaris*)
References: Brodo (2016), Flenniken (1999), McMullin and Anderson (2014)
No voucher information recorded

Hammered Shield Lichen (*Parmelia sulcata*)
References: Brodo (2016), Flenniken (1999)
No voucher information recorded

Mealy Rosette Lichen (*Physcia millegrana*)
References: CNALH (2017), Flenniken (1999), McMullin and Anderson (2014)
No voucher information recorded

Powderhorn Lichen (*Cladonia coniocraea*)
References: Brodo et al. (2001), Flenniken (1999), McMullin and Anderson (2014), Showman (2015)
No voucher information recorded

British Soldier (*Cladonia cristatella*)
References: Flenniken (1999), McMullin and Anderson (2014)
Vouchers: Gray (1930), Duppstadt (1970)

Pebbly Pixie Cup (*Cladonia pyxidata*)
References: Brodo (2016), CNALH (2017), Flenniken (1999), OMLA (2017)
Vouchers: Burrell (2011)

Gray Reindeer Lichen (*Cladonia rangiferina* syn. *Cladina rangeriferina*)
References: Brodo (2016), Flenniken (1999), McMullin and Anderson (2014)
Vouchers: Core (1946), Frye (1932), Gray (1939)

Olive Cladonia (*Cladonia strepsilis*)
References: Flenniken (1999), McMullin and Anderson (2014)
Vouchers: Gray (1927), Gray (1940), Gray (1940)

Dixie Reindeer Lichen (*Cladonia subtenuis* syn. *Cladina subtenuis*)
References: Brodo (2016), Flenniken (1999), OMLA (2017)
Vouchers: Core (1929), Gray (1935)

Pink Earth Lichen (*Dibaeis baeomyces*)
References: Flenniken (1999), McMullin and Anderson (2014), OMLA (2017)
Vouchers: Gray (1939), West (1935)

Common Greenshield Lichen (*Flavoparmelia caperata*)
References: Flenniken (1999), McMullin and Anderson (2014), Showman (2015)
Vouchers: Gray (1929)

Hooded Rube Lichen (*Hypgogymnia physodes* syn. *Parmelia physodes*)
References: Brodo (2016), Flenniken (1999), McMullin and Anderson (2014)
Vouchers: Gray (1928), Hale (1957), Unspecified (1937)

Jellyskin Lichen (*Leptogium lichenoides*)
References: Brodo (2016), CNALH (2017), Flenniken (1999), McMullin and Anderson (2014), Showman (2015)
Vouchers: Dey (1988), Fink (date unknown), Gray (1927)

Blackened Toadskin (*Lasallia pennsylvanica*)
References: Flenniken (1999), Showman (2015)
Vouchers: Gray (1939)

Lung Lichen (*Lobaria pulmonaria*)
References: Flenniken (1999), McMullin and Anderson (2014)
Vouchers: Unspecified (1937)

Salted Shield Lichen (*Parmelia saxatilis*)
References: Flenniken (1999), McMullin and Anderson (2014)
Vouchers: Sheldon (1937), Sheldon (1939)

Powdered Ruffle Lichen (*Parmotrema hypotropum*)
References: Brodo (2016), CNALH (2017), Flenniken (1999), Showman (2015)
No voucher information recorded

Common Dog Lichen (*Peltigera canina*)
References: Flenniken (1999), McMullin and Anderson (2014)
Vouchers: Ford (1983), Hale (1932), Studlar (2002)

Bitter Wort Lichen (*Variolaria amara* syn. *Pertusaria amara*)
References: Brodo et al. (2001), CNALH (2017), McMullin and Anderson (2014)
Vouchers: Sheldon (1904), Lendemer (2011)

Rock Rosette Lichen (*Physcia subtilis*)
References: Brodo (2016), Flenniken (1999)
Vouchers: Gray (1957), Gray (1958)

Island Gold Dust Lichen (*Chrysothrix insulizans*)
References: Brodo et al. (2001), Harris and Ladd (2008), Laundon (1981)
Vouchers: Clark (2010), Clark (2010)

Common Antler Lichen (*Pseudevernia consocians*)
References: CNALH (2017), Flenniken (1999), McMullin and Anderson (2014)
Vouchers: Gray (1940), Sheldon (1913)

Powdered Speckled Shield Lichen (*Punctelia caseana* syn. *P. subrudecta*)
References: Brodo (2016), Brodo et al. (2001), Flenniken (1999), Lendemer and Hodkinson (2010), McMullin and Anderson (2014)
Vouchers: Clark (2010), Unspecified (1937)

Rough Speckled Shield Lichen (*Punctelia rudecta*)
References: Flenniken (1999), McMullin and Anderson (2014)
Vouchers: Unspecified (1939), Unspecified (1939)

Nipple Lichen (*Pycnothelia papillaria*)
References: Flenniken (1999), McMullin and Anderson (2014)
Vouchers: Clark (2010), Gray (1939)

Sinewed Strap Lichen (*Ramalina americana*)
References: Flenniken (1999)
Vouchers: Burrell (2011)

Frosted Rock Tripe (*Umbilicaria americana*)
References: CNALH (2017), Flenniken (1999)
Vouchers: Clark (2010), Clark (2010)

Bristly Beard Lichen (*Usnea hirta*)
References: CNALH (2017), Flenniken (1999)
Vouchers: Gray (1932), Gray (1932), Fowler (2016)

Red Beard Lichen (*Usnea rubicunda*)
References: CNALH (2017), Flenniken (1999)
Vouchers: Cummings (1905), Frye (1937)

Bushy Beard Lichen (*Usnea strigosa*)
References: CNALH (2017), Flenniken (1999), McMullin and Anderson (2014)
Vouchers: Gray (1928), Unspecified (1929)

Pitted Stone Lichen (*Bagliettoa calciseda*) syn. *Verrucaria calciseda*)
References: Brodo (2016), Brodo et al. (2001), CNALH (2017)
Vouchers: Gray (1929)

Peppered Rock Shield (*Xanthoparmelia conspersa*)
References: CNALH (2017), Flenniken (1999)
Vouchers: Clark (2010), Clark (2010), Lachner (1931)

Lipstick Powderhorn, Scarlet Pin Lichen (*Cladonia macilenta* var. *bacillaris* syn. *C. bacillaris*)
References: Brodo (2016) Brodo et al. (2001), Flenniken (1999), McMullin and Anderson (2014)
Vouchers: Gray (1935), Gray (1939), Gray (1939)

Turban Lichen (*Cladonia peziziformis*)
References: Flenniken (1999)
Vouchers: Unspecified (2010)

Red-fruited Pixie Cup (*Cladonia pleurota*)
References: CNALH (2017), Flenniken (1999)
Vouchers: Gray (1940)

Dragon Cladonia (*Cladonia squamosa*)
References: CNALH (2017), Flenniken (1999)
Vouchers: Unspecified (2011)

Star-tipped Reindeer Lichen (*Cladonia stellaris* syn. *Cladina stellaris*)
References: Flenniken (1999), McMullin and Anderson (2014)
Vouchers: Ford (1983), Gray (1931)

Soil Jelly Lichen (*Enchylium tenax* syn. *Collema tenax*)
References: Brodo (2016), CNALH (2017), Flenniken (1999)
Vouchers: Sheldon (1907)

Brook Lichen, Stream Stippleback (*Dermatocarpon luridum*)
References: Brodo et al. (2001), CNALH (2017), Flenniken (1999)
Vouchers: Clark (2010), Gray (1923)

Common Stippleback, Leather Lichen (*Dermatocarpum miniatum*)
References: Brodo (2016), Flenniken (1999)
Vouchers: Gray (1939)

Script Lichen (*Graphis scripta*)
References: Brodo (2016), Brodo et al. (2001)
Vouchers: Gray (1939)

Common Toadskin (*Lasallia papulosa*)
References: Flenniken (1999), McMullin and Anderson (2014)
Vouchers: Burrell (2010)

Stonewall rim-lichen, Chewing Gum Lichen (*Protoparmeliopsis muralis* syn. *Lecanora muralis*)
References: Brodo (2016), Flenniken (1999), McMullin and Anderson (2014)
Vouchers: Ford (1983), Gray (1928)

Dust Lichen (*Lepraria* spp.)
References: Brodo et al. (2001), McMullin and Anderson (2014), Showman (2015)
Vouchers: Clark (2010)

Smooth Lungwort (*Lobaria quercizans*)
References: Brodo et al. (2001), Flenniken (1999), McMullin and Anderson (2014)
Vouchers: Unspecified (1939), Unspecified (1939)

Perforated Ruffle Lichen (*Parmotrema perforatum*)
References: Brodo (2016), Flenniken (1999)
Vouchers: Gist (1960), Gray (1939)

Water Fan, Water Dog Lichen (*Peltigera hydrothyria* syn. *Peltigera venosa*)
References: Brodo (2016), CNALH (2017)
Vouchers: Unspecified (1918), Williams (1908)

Many-fruited Dog Lichen (*Peltigera polydactyla*)
References: Brodo (2016), CNALH (2017), Flenniken (1999)
Vouchers: Sheldon (1909), Sheldon (1939)

Rock Strap Lichen (*Ramalina intermedia*)
References: CNALH (2017), Flenniken (1999)
Vouchers: Gray (1928)

Fringe Wrinkle Lichen, Variable Wrinkle Lichen (*Tuckermannopsis ciliaris*)
References: Brodo (2016), Flenniken (1999), McMullin and Anderson (2014)
Vouchers: Unspecified (1928), Gray (1935)

Plated Rock Tripe (*Umbilicaria muehlenbergii*)
References: Flenniken (1999), McMullin and Anderson (2014)
Vouchers: Clark (2010)

Plitt's Rock Shield, **Peppered Rock Shield Lichen** (*Xanthoparmelia plittii*)
References: CNALH (2017), Flenniken (1999), McMullin and Anderson (2014), OMLA (2017)
Vouchers: Clark (2010)

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