All you ever wanted to know (almost) about the Lichens of the West Kootenays

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The Tao of Lichen: living together for the common good

Lichens are two organisms in one: a **fungus** and a photosynthesizing organism, usually an **alga**. The organism we see and identify is the fungus. It gives the lichen its breadth and depth, much of its colour, its chemistry, and, in the last few centuries at least, its name. All lichen classification revolves around naming and describing the fungus. The second but not any less important component organism is usually an alga, more rarely a cyanobacterium. It lives embedded in the **thallus**, or "body" of the lichen, below protective layers of **cortex** and fungal hyphae (**medulla**). The alga occurs as individual cells or chains of cells. With careful observation of a clean cross-section of a thicker lichen thallus with a hand lens, it is usually possible to see a thin layer of algae. The algae contribute a certain degree of colour to the lichen, especially when wet, but most importantly they provide nourishment to the fungus in the form of photosynthetic carbohydrate products such as ribitol and sorbitol (in the case of cyanobacteria: glucose). The cell walls of algae living in association with fungi are permeable, allowing some of the metabolites produced during photosynthesis to be passed along to the fungus.

The cohabitation between fungi and algae has been immensely successful, leading to the formation of nearly 14,000 species of described lichens in all life zones. Lichens are a part of every North American biome. In British Columbia alone over 1,500 species have been recorded.

Lichens take on a variety of forms. Some are very conspicuous, like the hair lichens of mountain and boreal forests or the reindeer lichens of the northern Canadian and Arctic heaths. However, the majority of lichens are lowly organisms, trodden underfoot in the hustle-bustle of everyday life. They can be found everywhere, on sidewalks, fruit trees and concrete walls in cities, on asphalt and roof shingles.

Four major groups of lichens are typically distinguished:

- **Crust** lichens: These are lichens that live in intimate contact with their substrate; they have no undersurface. They can be **leprose** (dust), **areolate** (cracked), **rimose** (continuous)**,** or **lobate** (with marginal lobes), but in any case the lichen is inseparable from its substrate without destroying it.
- **Scale** lichens: Like fish scales, these lichens are attached to their substrate along one margin and free on all others, and they often overlap.
- **Leaf** lichens: Foliose lichens, like leaves of a plant, have an upper and lower side. The lower side often, but not always, forms small root-like structures called **rhizines** (Rhizinen) that serve no other purpose than the adhesion to the substrate.

- **Club, Shrub and Hair** lichens include all lichens that form bushes or hair, miniature "trees" or other bizarre three-dimensional club structures, such as those formed by the genus *Cladonia*.

Chemistry

Many lichens produce an array of secondary metabolites ("lichen substances") that are characteristic of the species or genera and extremely important in identification. Some are visible to the trained eye (e.g., usnic acid) while others can be demonstrated using simple chemical tests such as sodium or calcium hypochloride (Na(OCl) or Ca(OCl), the "C" test) or potassium hydroxide (KOH, "K" test). In these cases the cortex or medulla will react yellow to red or violet. Another common reagent is potassium iodide in the form of Lugol's solution (I/KI), which produces strongly blue reaction in tissues that contains starches. The presence and location of such starches in the ascus and apothecium is an extremely important classification criterion in lichens.

How lichens reproduce

Almost all lichens belong to the group of fungi classified as ascomycetes (true mushrooms are basidiomycetes). The preferred form of sexual reproduction is the **spore**, produced in a special sack termed an **ascus** (pl. asci). The asci, in turn, are embedded in the gel of small, usually round disks known as **apothecia** typically borne on the upper surface of the thallus. Asci typically contain 8 spores. Much of the classification and identification of lichens turns around the size and shape of the spores and the characters of the ascus and apothecia. The fruiting body need not always be an apothecium, however: **perithecia** are also common, differing from apothecia in that they are sunken into the thallus, and **lirellae** are similar to apothecia but differ in some microscopic structures as well as the fact that they are usually long and narrow instead of round.

Some lichens however have adopted other means of reproduction. They simply break into pieces, each piece containing a ready-to-go bundle of fungal hyphae and a few algal cells, to start a new lichen. Asexual reproduction takes many forms, including hyphal/algal bundles with a cortex (**isidia**) or without a cortex (**soredia**, the most common type), or the sort that breaks away from the thallus margins (**blastidia**). Soredia are often spread across the thallus or borne in special soredia pockets called **soralia**.

The Ecology of Lichens: where they will and will not live, and why

Lichens, unlike vascular plants, have no vascular tissues – no xylem, no phloem, and no roots – and consequently no way to transport water and nutrients from below their immediate point of attachment to any point above. This makes them very dependent on the water and nutrients located directly on the surface or provided in the air. Each lichen is thus physiologically finely tailored to the exact combination of daily moistening and drying, cooling and warming (sometimes to extreme temperatures) and trace elements offered in the few square millimetres it occupies. Lichens are, in other words, excellent ecological indicators.

There are several dividing lines in the lichen world that define where lichens live. One of these important dividing lines is substrate. Many lichens are **saxicoles** (lichens restricted to rock), and never or extremely rarely occur on trees. Those species that grow on trees likewise

are almost never on rock (but of course, there are exceptions). Among the tree-growing epiphytic species are the **lignicoles** (growing only on wood) and the **corticoles** (species on bark). Another diverse group of lichens includes the **terricoles** (species growing on soil) that occur on soil. When collecting a lichen it is very important to note on what substrate it was growing and to be very specific, mentioning also what species of tree it grows on and where on the tree (branches, trunk, fine twigs, etc.)

Nutrients: Lichens are very sensitive to the amount of nutrients available on any given growing site. As with higher plants and mosses, some can only grow where there is sufficient nutrient enrichment. On a generalised level, there are **calciphiles** (calcium-loving species that require nutrient enrichment) and **acidophiles** (acid-loving species). A calciphile will almost never occur on acidic, siliceous rocks, and vice versa, an acidophile will not occur on calcareous rock. In the West Kootenays some of the following general rules apply:

- Granite: very acidic rock with comparatively low species diversity (both on rocks directly and on trees that grow over these rocks)
- Schists, slates, argillites: sedimentary rocks with inclusions of calcium, so that there is a mix of acidophiles with some species that require enrichment.
- Limestone: there is no calcium limitation on limestone, so calciphiles are abundant, but acidophiles are rare.

The same goes for trees. Most of the common forest trees in the West Kootenays such as hemlock, western red cedar, spruce and balsam fir have acidic bark, but fruit trees (apples, pears, cherries), willows (*Salix*) and cottonwoods and quaking aspens (*Populus*) have base-rich bark. These tend to support epiphytic species typical of such habitats such as the colourful orange *Xanthoria* and *Caloplaca* species.

Interestingly, an acidic tree species, such as a conifer, will host more nutrient-demanding species if it grows over limestone than if it grows over an already very acidic bedrock type, such as granite.

References for learning more about lichens

The standard identification work for British Columbia is Parts 1 and 2 of *Lichens of British Columbia* by Trevor GOWARD (1995, 1999), published by B.C. Ministry of Forests. Part 3, which will deal with crustose, epiphytic lichen species, is in preparation (SPRIBILLE & GOWARD). Another upcoming field guide, complete with colour photos of hundreds of species, is Trevor GOWARD's *Ways of Enlichenment*, which should be available from Lone Pine Press in 2005.

Lichens of Southeastern British Columbia

The following is a brief, if incomplete, overview of the important lichens that grow on trees and rocks in the West Kootenays. It can serve as a reference list as we look at lichens during our Wilson Falls field trip, and help some of us visualise how some of these scientific names are spelled.

Common species on rock (saxicoles)

Stalked Fairy Upchuck (*Baeomyces rufus*)
Brownettes (*Melanelia* spp.)
True Crottle (*Parmelia saxatilis*)

On soil, humus, rotten logs (terricoles)

Reindeer Lichens (*Cladina rangiferina, Cladina mitis, Cladina arbuscula*)
Toy Soldiers / British Soldiers (*Cladonia bellidiflora*)
Singing Pyxie (*Cladonia cenotea*)
Powdered Pyxie-Cup (*Cladonia fimbriata*)
Branched Pyxie (*Cladonia multiformis*)
Greater Green-horned Pyxie (*Cladonia ochrochlora*)
Sulphur Pyxie-Cup (*Cladonia sulphurina*)
Fairy Barf / Fairy Upchuck (*Icmadophila ericetorum*)
Arctic Paw (*Nephroma arcticum*)
Freckle Pelts (*Peltigera aphthosa* group)
Thin-Skinned Dogpelt (*Peltigera membranacea*)
Foam or Cauliflower Lichens (*Stereocaulon* spp.)

On trees: epiphytes

Hair/Shrub lichens
Common Witch's Hair (*Alectoria sarmentosa*)
Dun Horsehair, Grey Horsehair (*Bryoria capillaris*)
Pale-footed Horsehair (*Bryoria fuscescens*)
Wolf Lichen (*Letharia vulpina*)
Beard Lichens (*Usnea* spp.)

Leaf lichens
Red-headed Greenhorn Pyxie (*Cladonia umbricola*)
Western Crottle (*Parmelia hygrophila*)
Hammered Crottle (*Parmelia sulcata*)
Green Starburst (*Parmeliopsis ambigua*)
Grey Starburst (*Parmeliopsis hyperopta*)
Grey Monk's Hood (*Hypogymnia physodes*)
Powder-Headed Birdbone (*Hypogymnia tubulosa*)
Lattice Birdbone (*Hypogymnia occidentalis*)
Wrinkled Birdbone (*Hypogymnia rugosa*)
Common Lung Lichen (*Lobaria pulmonaria*)
Common Rag Lichen (*Platismatia glauca*)
Silver-Lined Wrinkle (*Tuckermannopsis chlorophylla*)
Eyed Wrinkle (*Tuckermannopsis orbata*)
Wrinkled Wrinkle (*Tuckermannopsis platyphylla*)

Important crusts on bark
Pertusaria ophthalmiza
Bloody Heart (*Mycoblastus sanguinarius*)

Lichens and Oldgrowth Forest

While many common lichens can make a living on any ordinary tree branch, others are more finicky about their habitat requirements. In particular, there are some lichen species that avoid direct rainwater and sunlight, drawing their modest needs instead from humidity and refracted light. In addition, they appear to also require **ecological continuity**, in the form of a habitat that is stable and humid for a long period of time. For species with such requirements,

there is hardly a microsite that feels more like home than the base of a large cedar, or the underside of a leaning snag or large tree. And where, in turn, does one find more sheltered old trees and leaning snags than in an oldgrowth forest. A special group of crust lichens known as **calicioids** or pin lichens are specially adapted to the trunks of large, old trees in old growth forests around the temperate world, from the old growth spruce of Scandinavia to old growth cedar of British Columbia. In the West Kootenays, cedar is the preferred habitat of calicioid lichens. By carefully examining the bark of old cedars from the side angle – looking at the profile of the bark – it is often possible to make out the small pin-heads characteristic of calicioids. There are over 50 species of calicioid lichens in British Columbia.

Lichens and the Interior Temperate Rainforest

Of the many lichens species that are found in the forests of the West Kootenays, there is a special group that is found only in the wettest valleys, in the forests that remain moist and sheltered even in the driest of years. These are lichens that are primarily found in coastal rainforests, and then occur hundreds of kilometres from the coast in the inland rainforests. These species have proven useful in recent studies to define where inland rainforests occur and to map them. Since many of these species also occur around the spray zones of waterfalls, we will have an opportunity to see several of them during our field trip to Wilson Falls. They include:

Oceanic Birdbone (*Hypogymnia oceanica*)
Textured Lung (*Lobaria scrobiculata*)
Swiss Paw (*Nephroma helveticum*)
Peppered Paw (*Nephroma isidiosum*)
Cryptic Paw (*Nephroma occultum*) – a COSEWIC species of concern
Pimpled Paw (*Nephroma resupinatum*)
Devil's Matchstick (*Pilophorus acicularis*)
Tapered Matchstick (*Pilophorus clavatus*)
Twigbear (*Polychidium dendriscum*)
White Specklebelly (*Pseudocyphellaria anomala*)
Clustered Coral (*Sphaerophorus globosus*)
Ball-headed Coral (*Sphaerophorus tuckermanii*)
Peppered Moon Lichen (*Sticta fuliginosa*)
Moonshrub, "Mr. Wright" (*Sticta wrightii*)

And, so we haven't mist anything…

And, last but not least, one lichen that grows in the spray zones of waterfalls deserves mention. This is the yellow specklebelly, *Pseudocyphellaria crocata*, a species known from only two sites in western inland North America, both in the mist zones of waterfalls. It is characterised by its yellow dust in seams and pockets along the thallus. These are actually asexual reproductive structures termed soredia.

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