

Genus *Multiclavula* in Newfoundland and Labrador

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Abstract

Two members of the small genus *Multiclavula*, one relatively common and one relatively uncommon, found in Newfoundland and Labrador in 2008, are reported. Contemplation on their physiology and morphology opens some questions, if not insights, into the nature of lichens and allows for some speculation about the evolutionary relationships of fungi.

Key Words:

Multiclavula, *Multiclavula vernalis*, *Multiclavula mucida*, lichen, *Botrytis*, *Coccomyxa*

A lichen is an organism created by a physical and physiological incorporation of two or more organisms into one new structure, resulting in a different morphological shape from that of the component organisms; one of

the partners (symbionts) is always a fungus and the other(s) an alga and/or a cyanobacterium (Brodo et al., 2001). The lichen is known by the name of the fungus, because the fungus is the dominant partner in this arrangement: it encloses its smaller symbiont(s) in fungal tissue to form the new organism and determines the shape of the lichen thallus (the lichen “leaf”). The partners may be able to exist independently, although in most cases they are obligate associates, unable to live without a symbiont. Because both partners as well as their associations have evolved in varied ways at varied times, lichens do not form a phylogenetic, evolutionary or taxonomic group, but are defined by their physiology. Most of the fungi that form lichens are Ascomycetes (sac fungi). Only some 20 Basidiomycetes (fungi that sporulate from basidia and usually make fruiting bodies with a cap and stem, i.e. “mushrooms”) form lichens.

Genus *Multiclavula* was proposed by Petersen to include a group of club shaped Basidiomycetes of similar hyphal morphology, all but one seemingly obligate associates of other organisms (Peterson, 1967). The lichenized members of the genus straddle the lichen border: they enclose their algal partners in small capsules of mycelial tissue, but virtually unstructured, these algal capsules appear as a green granular scum on the surfaces where the mushroom fruits, producing

a “lichen” classically named *Botrydina* (Oberwinkler, 1984). Although both symbionts live in an obligate mutualistic association, they remain recognizable by their separate morphology. Thus, as far as the definition of lichen is concerned, the combination of obligate symbionts is present, a kind of thallus can be said to be formed, but the relationship is so loose that many authorities consider them separate organisms rather than a new, combined, organism.

We probably only have two species of *Multiclavula* in Newfoundland and Labrador, *M. mucida* and *M. vernalis*. The former is sufficiently common to be described in texts for our region by Barron (1999) and McNeil (2006), as well as in many texts from other regions in North America. It is rare in Europe and threatened in many countries (Randland et al., 2008), but seems to be found on all continents, save Antarctica. *Multiclavula vernalis* is also reported globally, limited to arcto-alpine habitats, often as a pioneer species in moist pioneer soils. (Pioneer soils are newly formed soils from the crumbling of rock caused by constant freeze and thaw and pioneer species are those species of complex organisms first to move into these soils, after algae and bacteria.) In North America, it seems to be an eastern species; arcto-alpine areas of the West have a close relative, *M. corynoides*, which resembles *M. vernalis* microscopically, but macroscopically is somewhere between the relatively robust *M. vernalis* and the fragile *M. mucida*. Collections of *M. vernalis* have been reported from western Labrador in 1963 (Kallio and Kankainen, 1964) (Twin Falls and Northwest River).

In 2008 we collected *M. mucida* from two sites in central Newfoundland (Corduoy Pond Trail near Grand Falls-Windsor and Notre Dame Park Ski Trail). We also collected *M. vernalis* from two places in central Labrador, both within 3 km of our base camp at Konrad Brook Pond (56° 13' 08.4" N, 62° 46' 37.6" W). Both were in depressed moist areas of relatively bare soil,



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although not true pioneer soil.

Figure 1 (page 30) shows both species *in situ*. We offer this communication because both occupy an interesting place at the edges of the lichen world, likely constitute a complete overview of the genus in our province and are rare: *M. mucida* in much of the world and *M. vernalis* here.

***Multidavula mucida* (Fries) Petersen**

Cap: 0.2-0.5 x 0.5-1.5 mm, fusiform, occasionally branched, often bent, sticky (note adherence of small debris) pale yellow or pinkish with darker

pointed tip. Stem: white translucent, about one-half as thin and short as cap, arising from small area of white mycelium. Habitat: hardwood or mixed forest. Substrate: barkless log, probably hardwood, covered with green scum of *Coccomyxa*. Habit: Gregarious. Season: Throughout the season, summer and fall. Microscopy: Basidia 4-6-spored, spores hyaline, ellipsoid 5-7 x 2.5-3 μ m.

***Multidavula vernalis* (Schweinitz) Petersen**

Cap: 1-8 x 10-27 mm, clavate to truncate, with furrows and knobs, glabrous, pale orange, tip sometimes

white. Stem: 2-5 x 5-10 mm, cylindrical, often bent, white, arising from very small area of white mycelium. Habitat: moist areas of bare soil. Substrate: bare soil covered with green scum of *Coccomyxa* (*Botrydina*). Habit: Gregarious. Season: entire season (short summer). Microscopy: Basidia 4-spored, spores hyaline, 8-12 x 2.5-3 μ m.

Discussion

The question of whether these organisms are true lichens or not may be somewhat confusing.

Continued on page 30.

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Multiclavula mucida, top, photographed in Central Newfoundland and *M. vernalis*, bottom, photographed in central Labrador. Note the green scum covering the substrate in both cases, unmistakable but less obvious on the mud of the lower photo.

Multiclavula continued from page 27.

Perhaps it is easier to consider them as an extreme form of ectomycorrhizal fungi. Ectomycorrhizal fungi form a mycelial mantle around root tips of their symbionts, not possible if the symbiont is a unicellular organism like an alga. In this case, might the thin envelope around the entire organism be the equivalent of the mycelial mantle? Genetic studies have placed *Multiclavula* in the Cantharellales—the cantharelloid clade—along with *Catharellus*, *Clavulina*, *Craterellus*, *Hydnum*, *Sistotrema* and others (Moncalvo et al., 2006). All of the other genera in that clade are ectomycorrhizal fungi. A lichen might seem an odd misfit in that company until one accepts the idea that in the case of *Multiclavula* the ectomycorrhizal association is modified for a unicellular organism. Parenthetically, strength to the argument that the cantharelloid clade consists of ectomycorrhizal fungi is given by the presence of *Sistotrema* in the clade. That genus was thought to consist only of saprophytes, but recent work has shown some species to be primarily mycorrhizal (Nilsson et al., 2006). At the same time, genetic studies have revealed *Sistotrema* to be a polyphyletic genus and only its mycorrhizal species share genetic similarity with members of the cantharelloid clade.

The foregoing suggests a simple, functional way to view fungi, functional because it seems to work and it classifies them according to function (physiology): divide fungi into those that get their carbon by digesting carbonaceous material and those that receive it from photobionts (organisms with chlorophyll that enables them to synthesize sugars from CO₂ with the energy of sunlight). In this division, parasites are subdivisions, not major categories, possible in both groups. The advantage of this *Pilzanschauung* is that the semantics of exactly how much fungal tissue around algae, the shape of the “thallus” or the degree of algal incorporation is needed to be called a lichen becomes somewhat moot. The mighty *Quercus* and the lowly *Coccomyxa* become equals, different expressions of a diverse fungal photobiontism, and envelopment, ectomycorrhiza and arbuscular mycorrhiza become but examples of mechanics.

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The Propagule

The old man steps off the passenger bus
and heads towards the forest's edge.

No one on board notices
the grey shadow on the empty seat.

It's twilight as the old man
moves between the trees, boots treading
on the silent soft brown earth.

Mushrooms sprout in his footsteps.
Black jelly fungi and colorful slime molds
begin to spread over tree and stone.
Large brain-like bodies swell in the gloom
while grey and ochre mildews multiply
in nurturing mist.

The man looks around him, then moves on;
the fruiting fungoids follow him.

Soon streams clot, roots rot;
the forest deadens, decomposes,
turns to swamp.

As night blooms around him,
the old man bursts into a cloud of spores
even as mist and moon mold over,
and the evening sky glows
oddly phosphorescent,
emerald green.

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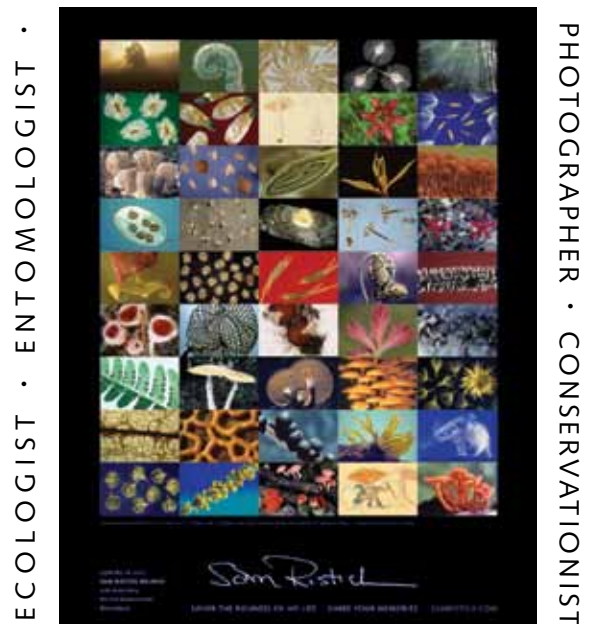


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