



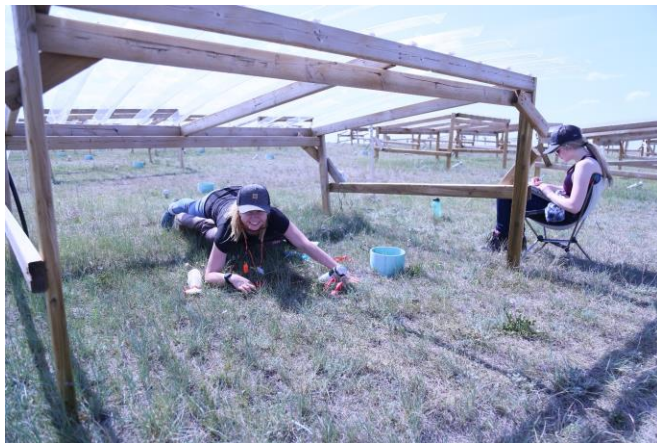
Finding new species of lichen

Prepared by Megan Lewis, Dr. Diane Haughland, and Dr. Cameron Carlyle

Biological soil crusts (BSC) are an important component of many ecosystems that are often overlooked because they occur on the soil surface, are small in stature and sometimes obscured by the overlying plant community. Yet despite their small size, BSC can make big impacts on ecosystem health by helping to cycle nutrients, protect soils from erosion, moderate soil moisture, and contribute a unique component of grassland biodiversity. Biological soil crusts are communities of different types of organisms including lichen, bryophytes and small statured vascular plants. They are also affected by land management and can serve as indicators of environmental change. Critically, the individual species within grassland BSC are not well described which makes it difficult to assess changes in these communities.



Megan holds a plug of biocrusts at the Mattheis Ranch containing two lichens: *Xanthoparmelia wyomingica* and *Cladonia symphylicarpa*



MSc student, Megan Lewis, and her field assistant, measure cover of biocrust constituents at the Mattheis Research Ranch.

Megan Lewis, an MSc student at the University of Alberta co-supervised by Drs. Diane Haughland and Cameron Carlyle, undertook a project to resolve the identity of some lichen species commonly found in grasslands, including the University of Alberta's Mattheis Research Ranch. The *Cladonia cariosa* group of lichen has imprecise taxonomic boundaries that may prevent observing changes in biocrust communities.

To resolve the species grouping within *Cladonia cariosa*, Megan measured morphological, chemical and molecular differences from many individual *Cladonia* specimens that were collected from throughout their nearly-global range (Plates 1 and 2 show morphological differences between the species). Megan's combined dataset suggests that where we had previously identified three species (*Cladonia cariosa*, *Cladonia symphycarpa*, and *Cladonia acuminata*) there were two additional undescribed species (Figure 1, Plates 1 and 2). One of the potentially new species occurs in Alberta, including at the Mattheis Ranch, while the second appears to be limited to Europe.

Megan's work has highlighted the undescribed biological diversity right beneath our feet. However, the identification of BSC is challenging and often considered a highly specialized skill set. Without increased taxonomic training for lichen and better resources for lichen identification we may unknowingly misidentify or lose species from our grassland ecosystems.



Closeup of *Cladonia* cup lichen. Photo by Megan Lewis.

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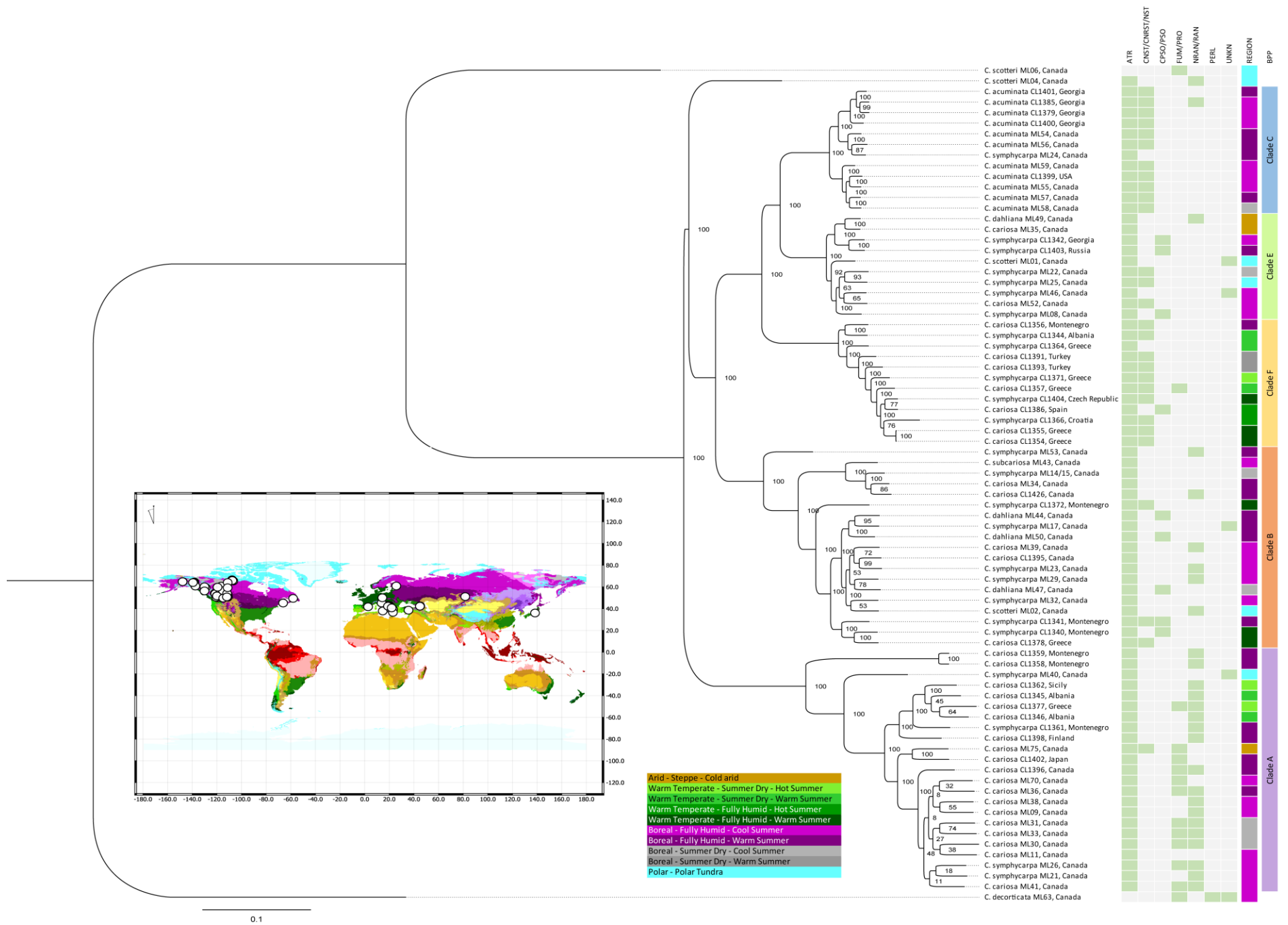


Figure 1. Family tree of the *Cladonia cariosa* group based on maximum likelihood analysis of a single nucleotide polymorphism (SNP) dataset produced by a Genotyping by Sequencing (GBS) method (LnL = -6,771,611.51). Bootstrap values are noted at tree nodes. Secondary metabolites present in specimens are denoted with green boxes next to the specimen name. Secondary compound abbreviations: ATR = atranorin, CNST = constrictic acid, CNRST = connorstictic, CPSO = conpsoric acid, FUM = fumarprotocetraric acid, NORAN = norrangiformic acid, NST = norstictic acid, PSO = psoromic acid, RANG = rangiformic acid, UNKN = unknown compound. The Koppen-Geiger climate classification of the specimen is denoted in the region column, and the Bayesian Phylogenetics and Phylogeography species delimitation results are denoted in the final column.

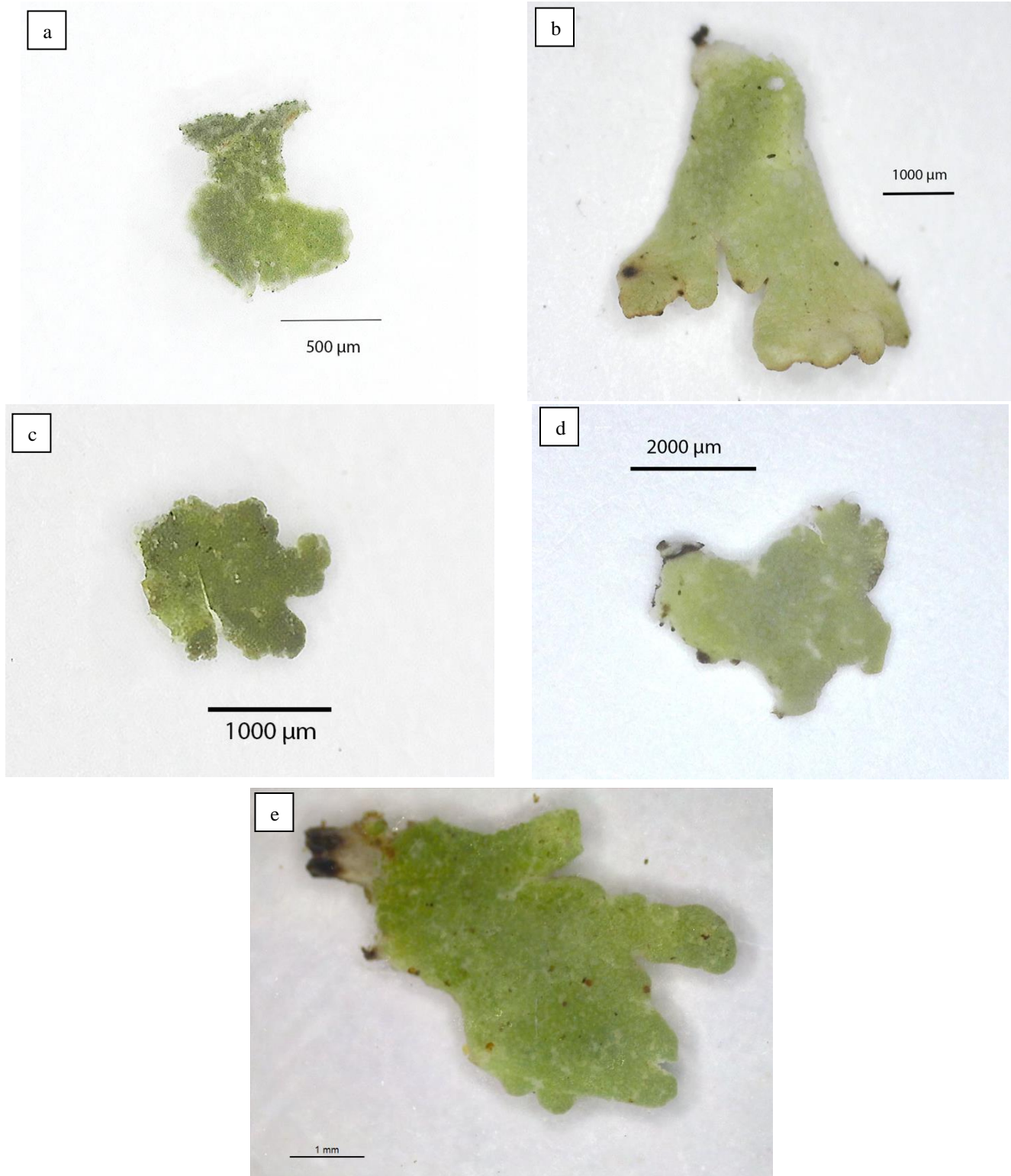


Plate 1. Side-by-side photographs of representative squamules from delineated genetic species *C. cariosa* (a), *C. symphyarpa* (b), *C. acuminata* (c), Clade E (d), and Clade F (e).



Plate 2. Side-by-side photographs of representative fruiting structures from delineated genetic species *C. cariosa* (a), *C. symphyarpa* (b), *C. acuminata* (c), Clade E (d), and Clade F (e).