

PhD Dissertation Defense

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Title: Evolution And Diversity Of The Tropical Basidiolichen Clade *Dictyonema* Sensu Lato (Agaricales: Hygrophoraceae)

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ABSTRACT

Lichenized basidiomycetes represent a small group within Basidiomycota, with *Dictyonema* s.lat. the clade with the highest number of species. It occurs world-wide, but has its highest diversity in tropical montane regions. The photobionts are cyanobacteria of the genus *Rhizonema*, which are thought to be entirely lichenized. Recent field observations and laboratory investigations indicate that more than 500 species belong to the *Dictyonema* clade, but genus and species concepts are still to be established. Prior to these investigations, taxonomic concepts for the clade were based largely on anatomy, with morphological differences being treated as intraspecific variation, with only few species accepted. In an attempt to elucidate the evolution of the group and the diversity of species in *Dictyonema* s.lat., morphological, anatomical, ecological and molecular analyses were performed using more than 800 samples from 19 countries. The sequences were generated by Sanger and next-generation sequencing procedures, and then phylogenetic reconstructions were done using the markers ITS, LSU and *RPB2* for the fungal partner and 16S rRNA for the photosynthetic partner. The multilocus and individual marker analyses indicated that the group is monophyletic with

five genus-level groups: *Cyphellostereum*, sister genus to the rest of species, *Dictyonema* s.str. forming a paraphyletic transitional group, and three additional monophyletic genera, *Acantholichen*, *Cora*, *Corella* and. In the Galapagos Islands, our focused sampling yielded 95 sequenced specimens representing ten species of *Dictyonema* s.lat., with eight being new and endemic to the islands. Results also demonstrated that *Acantholichen*, originally thought to be monotypic, is like other genera in the *Dictyonema* clade, highly endemic and made up of several species. The project also investigated the diversity of the cyanobacterial *Rhizonema* photobionts of *Dictyonema* s.l., generating 16S sequences from 560 *Dictyonema* specimens. Analyses of these sequences indicated that, unlike the diversity of the fungal partner in these lichens, very few *Rhizonema* lineages are present, suggesting that these photobionts are largely shared among mycobionts (from the same or different species, including ascolichens). In conclusion, the results of this study support the idea that *Dictyonema* s.l., previously considered to represent few species in a single genus, actually includes a remarkably high diversity of species in several distinct genera, differing in morphology, anatomy, substrate ecology, and distribution.