Learning about the mating systems of lichen-forming fungi using genomic information

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Unlike most animals, fungal species can reproduce asexually. Some never have sex at all. When they do, the majority of fungal species can only mate if two different individuals interact. These species are said to be *heterothallic*. In some special cases, a single individual can self-fertilize, and then the species is called *homothallic*. Genetically, a single section of the genome called the **MAT** (from *ma*ting *t*ype) **locus** is responsible of conferring this reproductive identity. Heterothallic individuals have only one variant of the MAT locus, while homothallic species normally have two variants. Sometimes, species that we thought never had sex actually do in unknown situations. Therefore, analysing the genes contained within the MAT locus can help us determine if a given species is heterothallic, homothallic, or if they never have sex (in which case we would expect to find broken genes).

A large fraction of fungal biodiversity form *lichens*, that is, symbiotic associations between green algae or blue-green algae, and a single fungus. However, because lichens are extremely hard to cultivate and because they grow so slowly, we know very little about the mating systems of the fungal partners. Therefore, this study focused on a family of lichen-forming fungi called Icmadophilaceae, which includes several species that regularly have sex, and some that we think never do (asexuals). I analysed their genomes (that is, all of their genetic material) to find the MAT locus and to characterize its genes. I found that the putative asexual species *Thamnolia vermicularis* and *Siphula ceratites*, as well as the sexual species *Dibaeis baeomyces* have a gene configuration concordant with heterothallism, while the sexual species *Icmadophila ericetorum* is most likely homothallic. Additionally, I applied a number of methods to detect genetic signatures of sex (recombination) in *T. vermiculars* populations from the Northern Hemisphere. Like previous studies, I found very little genetic variation across populations and no signs of sexual reproduction. This seems to be in contradiction with the qualities of its MAT locus, but it stimulates further research in this enigmatic species. On the other hand, exploratory analysis revealed that the lichen association of *S. ceratites* includes also a particular type of bacteria called Alphaproteobacteria. Overall, my results offer a wealth of information for new and more advance research into the reproductive and evolutionary biology of Icmadophilaceae species, an unexplored portion of fungal biodiversity.

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