A review of a doctoral thesis by Dovilë Barcytė:

Diversity of microalgae from extreme habitats: linking phylogeny and ecology

A research in taxonomy and diversity of algae has a long tradition, however, the diversity of algae in extreme environments is still only poorly understood. The doctoral thesis of Dovilë made a significant leap forward. The thesis covers a wide range of taxa from green cocoid and monadoid green algae to red algae. Both hot and cold extremes as well as acidic and terrestrial environments were investigated.

Dovilë applied mostly standard methods and techniques used in the research in diversity of algae. Strains were isolated into clonal cultures and several genetic markers were sequenced. Afterwards, single-gene phylogenies were estimated. Morphological characters were evaluated by a variety of microscopy techniques including electron microscopy. I would like to emphasize one method, which is used less commonly among algae. Raman microscopy (in paper VIII) provided a unique insight into the role of phosphorus in Arctic desmid *Cylindrocystis*. Most of the papers contained also an inference of secondary structure of internal transcribed spacer.

Dovilë’s thesis has a following structure: Introduction, Aims of the thesis, Outline of the papers and Conclusion section followed by attached papers. The introduction covers most of the topics discussed in attached papers. It is comprehensive and it helps reader outside of the field to understand basic concepts involved in the ecology of algae in extreme environments. I only miss here at least short chapter dedicated to explanation of current concepts in taxonomy of algae. Further, I greatly appreciate the chapter ‘Outline of the papers’, it helps with an orientation in such vast thesis which
contains quite distinctive topics. The first look made me think that the thesis is perhaps too complex, but Dovilė was capable to navigate a reader and made all parts understandable.

The thesis contains eight published papers and two manuscripts which have already been submitted to journals. All papers were published or submitted to good journals and Dovilė is the first author in all of them. Thus, she contributed most significantly to all the papers included in the thesis. This evidences that she is capable of preparation of high-quality papers and her contribution to the field of algal taxonomy and ecology has already been significant.

Dovilė’s thesis is exceptional by an incredible amount of time she must have spent doing fieldwork, isolating strains and molecular analyses. It is a huge piece of high-quality algological research and therefore I am happy to recommend acceptance of Dovilė’s thesis at Charles University.

Some questions and a comment:

*Coccomyxa* seems to by a well-mixed complex of paraphyletic and polyphyletic lineages. What would be your taxonomic solution to this conundrum?

The phylogeny on page 74 shows that *Galdieria sulphuraria* is composed of several clades. They are connected by poorly supported nodes. This indicates that they may not belong to one monophyletic group. Are those cryptic species? How would you define cryptic species in *Galdieria* and in general?

*G. phlegrea* and *G. sulphuraria* were sampled from the same localities in Italy (tree on page 74). Is it an example of sympatric speciation? Or are there perhaps different ecological preferences of these species?

What was the reason for such low node supports in CaM gene phylogeny on page 75? It looks to me as a poor alignment.

Page 92. You say: “The topology of our phylogenetic tree (Fig. 2) shows a rather separate and basal position of this sequence relative to other sequences designated *G. phlegrea*. This suggests that *G. phlegrea* may harbor a hidden biodiversity and that
extended sampling could uncover more cryptic species.” Can you be more specific which lineages you consider as cryptic species?

You note on page 146 that “The phylogenetic species concept dominates algal taxonomy”. Is there any way how to apply biological species concept in algae you studied? Do you think that it is important to state what species concept is used for a particular new species description?

Page 149. “The ITS2/CBC concept provides complementary information for species delimitation, but it should not be taken for granted because different algal groups and taxa have different evolutionary histories.” Also, different parts of the genome have different evolutionary histories. Thus, I would say that an importance of conservative markers should not be overestimated either to your “the value of conserved molecular markers should not be underestimated.” It has been shown many times that several markers can have only limited resolution on a species level.

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