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Review – PhD thesis of Mgr. Lenka Procházková
"Exploring the diversity of snow algae using polyphasic approach"

Snow algae are known as green and red snow phenomenon for centuries. Microscopic observations of coloured snow have revealed that snow algae belong mostly to the green algae. Several hundred species of snow algae have been described from both Polar regions as well as from glaciers of alpine and other high mountains around the world. These descriptions, however, are mainly based on the morphological species concept. Most snow algae have a complex, not fully understood life cycle, which makes a unique species identification very difficult. Previous phylogenetic analyses of SSU rDNA sequences have revealed that most of traditional green algal genera are polyphyletic, but very little is known about the molecular phylogeny of snow algae. The same holds true for comprehensive ecophysiological and molecular-biological studies to better understand the underlying mechanisms for acclimation and adaptation of snow algae to their cold habitat.

Therefore, in the present PhD thesis **Lenka Procházková** investigated various green algal members of the Chlamydomonadales using a so-called polyphasic approach to address their identity and phylogenetic position. The candidate applied several molecular markers in combination with cell biological traits to provide strong evidence for description of new taxa as well as for some taxonomic revisions. All these data contribute to a better understanding of the biodiversity and phylogeny of snow algae.

The second aspect of the PhD thesis of **Lenka Procházková** focussed on ecophysiological and biochemical mechanisms of snow algae to cope with the unique environmental conditions on top and inside a snow column. Besides rapid light curve measurements using photosystem II fluorescence as marker for light acclimation, also biochemical traits such as fatty acid and pigment profiles were determined. Fatty acids reflect the physico-chemical properties of membranes and serve as storage compounds, while data on pigments are important to understand the plasticity and tolerance of photosynthesis under fluctuating and enhanced PAR and UVR conditions. These aspects are well addressed in some of the chapters of the PhD thesis.

The PhD thesis of **Lenka Procházková** is rather outstanding according my long-term experiences as reviewer because it consists the amazing number of 10 publications, 4 with first authorship, 4 with second authorship and 2 with co-authorship. All papers are published in internationally acknowledged, peer-reviewed journals. Therefore, I like to highlight that **Lenka Procházková** has an excellent publication record in terms of her age and young career status.

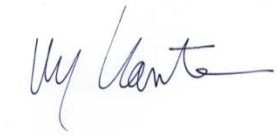
The PhD thesis is well structured as it contains a general introduction into the topic which equals a state-of-the-art review on the biology of snow algae, by addressing questions concerning habitat, taxonomy and phylogeny, biogeography, ecophysiology and biochemistry, and ecology – the ecology of these specialized algae is also discussed in the context of global warming. The general introduction equals a synthesis and is followed by the research objectives and main methods applied, as well as by a summary and outlook. All mentioned aspects are comprehensively discussed in the frame of about 200 references.

Nevertheless, I have also to mention some minor critical points:

1. The discussion of species-specific viral infections as a cue affecting snow algal life cycle seems to be rather weak, because this statement is only supported by a paper on a marine diatom. Indeed, viral infections are well documented as one mechanism for break-down of temperate phytoplankton blooms in the oceans. My questions are therefore – are there viruses reported from the snow habitat that might affect snow algae? Is there any molecular (metagenomic) or ultrastructural (TEM) evidence pointing to the presence of viruses? If such a hypothesis exist it should be methodologically quite easy to prove or disprove the existence of virus particles.
2. The first chapter on the role of snow algae in ecosystems is a bit confusing and unclear because of unusual wording and missing units. Number of cells per ml should be expressed as "cell number", "cell density" etc., but NOT as "concentration". "areal biomass concentration was estimated to be 0.033 g/m2" – g of what? I guess carbon or dry weight is meant.
3. The discussion on areal primary production and biomass is unclear. Most important is to carefully describe how much biomass (on a carbon or chlorophyll basis) is present in snow fields and compare such data with other algal communities (biological soil crusts, biofilms on bark of trees, buildings etc., periphyton etc.). The second step is then to evaluate primary production on a diurnal, saisonal and annual scale by providing numbers and again compare these data with other algal communities. The question arises – are snow algae communities productive compared to other systems? Do they thrive better under cold conditions?
4. Metagenomic profiling indicated the co-occurrence of snow algae and different bacteria. Do these algae have a specific microbiome? If yes, might these bacteria control/influence the reproductive cycle?

In summary, in spite of my minor critical points, I think the present PhD thesis of **Lenka Procházková** represents an interesting and innovative piece of original research, fully comparable to the international standards, and hence should be accepted without any problems by the Faculty of Science, Charles University in Prague. If I could give a grade as at the University of Rostock, my recommendation would be magna cum laude (very good, 97%).

My recommendation: **pass**



(Prof. Dr. Ulf Karsten)