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Review of habilitation thesis by Petr Dvořák

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Dear Dr. Jiří Neustupa,

It is my pleasure to provide my review of the habilitation thesis with the title: “Evolution of cyanobacteria – difference (almost) without distinction” by Petr Dvořák who is applying for promotion to Associate Professor. I am well familiar with Petr’s research and scholarly activities in the field of cyanobacterial biology. I know him as an active and productive scientist contributing many new insights into cyanobacterial genomics, evolution, and systematics. Below, I will discuss the strengths and weaknesses of the thesis as well as provide my opinion on his research accomplishments as a phycologist to date.

Strengths of the habilitation thesis

It is clear that Petr has an active research program as evidenced by a long list of first author publication (10 first author publications and two book chapters). Further, he coauthored numerous articles with colleagues from his extensive national and international collaboration network. Petr works on broad and modern topics in cyanobacterial evolutionary biology and systematics with topics including: describing new taxa to science, contrasting morphological with molecular traits regarding their phylogenetic information, investigating phylogenetics and phylogenomics to understand cyanobacteria evolution, identifying cryptic speciation, and sequencing herbarium specimen to reconstruct evolutionary history in cyanobacteria. His thesis showcases nicely his innovative use of molecular biology and genomics tools to study questions in cyanobacterial evolution and systematics, e.g., using next generation sequencing approaches in his herbarium specimen work or mining DNA sequence databases with bioinformatics such as using automatic species delimitation approaches to estimate cyanobacterial diversity based on both cultured and uncultured sequenced cyanobacteria. He also made substantial contribution in advancing cyanobacterial taxonomy of sub-tropical and tropical taxa. Lastly, his work provides additional lines of evidence for the frequent occurrence of convergent evolution of many phenotypic traits in cyanobacteria.

Weaknesses of the habilitation thesis

In the chapter “Speciation and species concepts in cyanobacteria” Petr did a nice job introducing the reader to genetic and genomic characteristics and diversification mechanisms in prokaryotes in general. Unfortunately, the reader is left to assume that characteristics such as larger population sizes, long distance dispersal, fast generation times, small genomes are universal and thus also apply to cyanobacteria. But do we have the evidence that those

generalities apply to all groups of cyanobacteria? Evidence exist that may demonstrate alternative mechanisms: e.g., causing larger genome sizes in some cyanobacteria (*Hassallia byssoidea* VB512170 with 13 Mb), slow growth (*Halomicronema hongdechloris* Li et al. 2014), or the existence of localized and rare populations (Flechtner et al. 2002, Rehakova et al. 2007, Osorio-Santos et al. 2014). I feel all possibilities should be considered and there may not be a “one story fits all” explanation.

Secondly, I felt that the thesis needed stronger evidence for phenomena such as HR to occur in cyanobacteria or what the specific drivers for reported HGT occurrences and accessory gene accumulation in cyanobacteria. I think it is ok to state that we don’t know how this works in Cyanobacteria and such statement would actually strengthen the scientific merit of Petr’s work.

Lastly, I felt a more extensive literature review was needed particularly for the section on “Two decades of great taxonomic boom of cyanobacteria”. It was especially missing the incorporation of recent taxonomic treatments and references that are based on the botanical code of nomenclature (ICN). Fundamental pieces of literature such as the instrumental work by Komárek and Johansen et al. should be discussed and referenced when one talks about Cyanobacterial taxonomy and systematics in the modern era. Petr also overlooked the extensive recent taxonomic work from drylands, which especially contributed to taxonomic revisions of the polyphyletic *Leptolyngbya* and *Microcoleus* genera.

General research accomplishments

Petr is currently a researcher at the Department of Botany of Palacký University Olomouc. Petr is well known, highly cited, and respected in the field of Phycology and is academically well connected within Europe and internationally. He is very proficient in the molecular techniques of studying cyanobacteria. He made substantial contributions to the field on cyanobacteria systematics and evolution. He publishes in high impact journals such as *Journal of Phycology*, *Phycologia*, *Biodiversity and Conservation*, *Molecular Ecology*, *PLoS ONE* among others. His h-index is 13 and i10- index is 17 and his works has been cited 643 times. His lead author paper on “Species concepts and speciation factors in cyanobacteria, with connection to the problems of diversity and classification” published in *Biodiversity and Conservation* is the most cited of his work with 99 citations (15 August 2021). I recognize Petr as one of the leading experts in cyanobacteria genomics and see him develop into a global expert in this area.

In summary, Petr has a strong trajectory in scientific productivity. He is driven by his goals, and he will without question be a major force in cyanobacterial biology addressing key questions in evolutionary genomics, advancing our understanding of biodiversity. Through his high motivation and passion for science he will be an outstanding role model to students, colleagues, and other co-workers. Please don’t hesitate to contact me for further information.

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