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Polyphasic characterization of *Trichocoleus desertorum* sp. nov. (Pseudanabaenales, Cyanobacteria) from desert soils and phylogenetic placement of the genus *Trichocoleus*

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Abstract

Little is known about the taxonomic diversity of cyanobacteria in deserts, despite their important ecological roles in these ecosystems. In this study, cyanobacterial strains from the Atacama, Colorado, and Mojave Deserts were isolated and characterized using molecular, morphological, and ecological information. Phylogenetic placement of these strains was revealed through Bayesian and parsimony-based phylogenetic analyses utilizing sequences of the 16S rRNA gene and the associated 16S–23S ITS region. Based on the combined evidence of this polyphasic approach, a new species from desert soils morphologically corresponding to the genus *Trichocoleus* was described. *Trichocoleus desertorum* sp. nov. Mühlsteinová, Johansen et Pietrasiak was used to obtain a phylogenetic reference point for *Trichocoleus*, a genus so far characterized by morphological description only. Through characterization of this new taxon in desert soils we hope to contribute to the general understanding of cyanobacterial diversity in extreme arid habitats.

Introduction

Arid lands represent biologically challenging but important ecosystems that extend over one third of the earth's land surface (Warren-Rhodes *et al.* 2007). Eukaryotic algae and cyanobacteria have been long recognized as crucial organisms playing a number of essential ecological roles in this harsh environment. Multiple studies have shown beneficial effects of microbiotic soil crusts as well as free living edaphic cyanobacteria, including increased soil stability, water penetration, and nutrient availability (e.g. Belnap & Gardner 1993, Evans & Johansen 1999). However, despite the ecological importance of algae and relatively long history of microbiotic soil crust research (*cf.* Phillipson 1935), we are still far away from a full understanding of cyanobacterial diversity in the soils of arid and semi-arid lands.

Our study took place in three different deserts—the Atacama Desert in Chile and the Colorado and Mojave Deserts in California. Whereas the research of North American deserts has resulted in description of several new cyanobacterial genera—such as *Mojavia* Řeháková & Johansen in Řeháková *et al*. (2007: 488) and *Spirirestis* Flechtner & Johansen in Flechtner *et al*. (2002: 7), our knowledge of algal communities inhabiting the Atacama Desert is still rather poor. Research in this desert has focused mainly on revealing how organisms are able to withstand extreme conditions in soils considered nearly Mars-like (Navarro-González *et al.* 2003), rather than investigating their finer taxonomic diversity (e.g. Wierzchos *et al.* 2006, Azúa-Bustos *et al*. 2011). In this work we hope to contribute not only to a further understanding of cyanobacterial diversity in general, but also to an understanding of the microflora in extreme desert environments.

Trichocoleus Anagnostidis (2001: 369) is a genus of filamentous cyanobacteria with parietal thylakoids, simple binary fission, and no specialized cells, distinguished from similar genera by the presence of multiple trichomes in a common sheath (Komárek & Anagnostidis 2005). This genus was created relatively recently (Anagnostidis

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