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Title: *Cyanobacteria in Arctic and Antarctic freshwaters: their diversity and toxicity*

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Cyanobacteria are photosynthetic bacteria with a worldwide distribution. They thrive in extreme environments and represent the predominant primary producers in freshwater streams, ponds, and lakes of the high polar regions. The large cyanobacterial mats and colonies are the nutritional basis and micro-habitat for several other types of organisms (primarily proto- and metazoans). Because of their simple trophic structure and sensitivity to climate change, cyanobacterial mats are an ideal model system for the exploration of climate induced changes in the polar regions. Cyanobacteria moreover synthesize multiple secondary metabolites, some of which are toxic to most higher organisms, including humans. On a worldwide scale toxin production appears to be increasing, possibly as a consequence of a warming climate. It can therefore be hypothesized that, as a consequence of climate change, the composition of cyanobacterial mat communities in the polar regions may change with a simultaneous increase in toxin production.

Here we describe the diversity of several cyanobacterial communities from the Arctic and the Antarctic and demonstrate that different cyanobacterial toxins (Saxitoxin, Microcystin, and Cylindrospermopsin) are present in these habitats. Characterization of the cyanobacterial diversity was accomplished on molecular level by a combination of automated ribosomal intergenic spacer analysis (ARISA) and „Next-Generation-Sequencing“ based on the 454® technology. Using these methods a comprehensive picture of the phylogenetic diversity could be obtained and mats from the Arctic and the Antarctic region compared with and within each other. In the Arctic two cyanobacterial toxins were recorded for the first time by ELISA (Enzyme Linked Immuno Sorbent Assay) as well as analytical methods: An unusual variant of the cyanobacterial hepatotoxin microcystin as well as the neurotoxic saxitoxin. In the Antarctic, next to Microcystin, which was previously known from that region, cylindrospermopsin was detected for the first time. The effect of climate change on the diversity and toxicity of cyanobacterial mats was

studied in a laboratory based approach. Temperatures of 8 - 16 °C resulted in a higher concentration of microcystin compared to 4 and 23 °C, as well as in structural changes of the community composition. Based on the results presented in this as well as in previous studies, it may be expected that climate change will affect the toxicity of cyanobacteria in the polar regions as well as in lower latitudes. It remains to be evaluated how toxin production will affect the habitats in the polar regions and thus the respective ecosystems as a whole.