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Phototrophic microorganisms in biofilm samples from Vernjika Cave, Serbia

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Caves represent specific natural monuments in terms of structure, complexity and beauty which can be found worldwide. Even though they are considered extreme environments, they are still a unique habitat for a large number of organisms that grow and proliferate here. Often can be seen that the cave walls are differently coloured as a consequence of the biofilm development. Biofilms represent complex communities of microorganisms that can develop on different kind of surfaces, including various rock surfaces. Each microbe species play a different role in a community, but their development on stone surfaces can cause substantial damage to the substrates through different mechanisms of biodeterioration and degradation. There is an increased interest in the phototrophic component of biofilms (aerophytic cyanobacteria and algae), especially cyanobacteria, an ancient microorganisms capable to survive the most diverse extreme conditions. These phototrophs can easily be found at cave entrances illuminated by direct or indirect sunlight and areas near artificial lights.
Cyanobacteria and algae were investigated in biofilm samples taken from the entrance of Vernjika Cave in Eastern Serbia. Cyanobacteria, Chlorophyta and Bacillariophyta were documented, with Cyanobacteria as a group with the highest number of recorded taxa. Chroococcalean species were the most diverse with the most frequently encountered species from the genus Gloeocapsa. Phormidium and Nostoc species were commonly recorded Oscillatoriales and Nostocles, respectively. Among Oscillatoriales species, it was noticed that one Phormidium species precipitates $CaCO_3$ on it's sheats. Trebouxia sp. and Desmococcus olivaceus were frequently documented Chlorophyta, and representatives of Bacillariophyta were exclusively aerophytic taxa, mostly belonging to the genera Luticola and Humidophila. Measured ecological parameters, temperature and relative humidity, were influenced by the external climatic changes, while light intensity values showed significant differences among sampling sites, even though sampling sites were relatively close to each other. Chlorophyll a, water content and content of organic and inorganic matter were determined from each biofilm sample. Chlorophyll a content showed positive correlation with the content of the organic matter.
Since cave microbiology is recognized as a growing interdisciplinary field, the exploration of phototrophic diversity is considered to be a contribution to this issue and the basis for further research that will include more experimental studies.