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# Biofilm community composition is changing in remote mountain lakes with a relative increase in potentially toxigenic algae

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## Résumé

Mountain lakes provide clear drinking water to humankind but are strongly impacted by global change. Benthic biofilms are crucial for maintaining water quality in these oligotrophic lakes, yet little is known about the effects of global change on mountain biofilm communities. By combining analyses of metabarcoding data on 16S and 18S rRNA genes with climatic and environmental data, we investigated global change effects on the composition of biofilm prokaryotic and micro-eukaryotic assemblages in a five-year monitoring program of 26 Pyrenean lakes (2016–2020). Using time-decay relationships and within-lake dissimilarity modeling, we show that the composition of both prokaryotic and micro-eukaryotic biofilm communities significantly shifted and their biodiversity declined from 2016 to 2020. In particular, analyses of temporal trends with linear mixed models indicated an increase in the richness and relative abundance of cyanobacteria, including potentially toxigenic cyanobacteria, and a concomitant decrease in diatom richness and relative abundance. While these compositional shifts may be due to several drivers of global change acting simultaneously on mountain lake biota, water pH and hardness were, from our data, the main environmental variables associated with changes for both prokaryotic and micro-eukaryotic assemblages.

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\*Intervenant

Water pH and hardness increased in our lakes over the study period, and are known to increase in Pyrenean lakes due to the intensification of rock weathering as a result of climate change. Given predicted climate trends and if water pH and hardness do cause some changes in benthic biofilms, those changes might be further exacerbated in the future. Such biofilm compositional shifts may induce cascading effects in mountain food webs, threatening the resilience of the entire lake ecosystem. The rise in potentially toxigenic cyanobacteria also increases intoxication risks for humans, pets, wild animals, and livestock that use mountain lakes. Therefore, our study has implications for water quality, ecosystem health, public health, as well as local economies (pastoralism, tourism), and highlights the possible impacts of global change on mountain lakes.

**Mots-Clés:** climate change, cyanotoxins, metabarcoding, microbial diversity, mountain lakes, water quality