The microbial community, its biochemical potential, and the antimicrobial resistance of Enterococcus spp. in Arctic lakes under natural and anthropogenic impact (West Spitsbergen).

Author: Agnieszka Kalinowska
Katarzyna Jankowska
Sylwia Fudala-Ksiazek
Mattia Pierpaoli
Aneta Luczkiewicz

Author Affiliation: Department of Water and Wastewater Technology, Faculty of Civil and Environmental Engineering, Gdansk University of Technology, 11/12 Narutowicza St., Gdansk 80-233, Poland. Electronic address: agnieszka.kalinowska@pg.edu.pl.

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Abstract: The sustainable management of small human communities in the Arctic is challenging. In this study, both a water supply system (Lake 1) under the natural impact of a bird-nesting area, and a wastewater receiver (Lake 2) were analysed in the vicinity of the Polish Polar Station on West Spitsbergen. Microbial community composition, abundance and activity were assessed in samples of the treated wastewater, lake water and sediments using next-generation sequencing and direct microscope counts. Special attention was given to the faecal indicator, Enterococcus spp., whose occurrence and antimicrobial resistance were tested in water and wastewater samples. The results indicate that Lake 1, at a tundra stream discharge (L-TS) and a water supply point (L-WS) were dominated by three phyla: Proteobacteria (57-58%) Bacteroidetes (27-29%) and Actinobacteria (9-10%), showing similar microbial composition up to the genus level. This suggests that nutrient-rich runoff from the bird colony was retained by surrounding tundra vegetation and reached Lake 1 at L-TS to a limited extent. Lake 2, being the wastewater recipient (WW-R), mirrors to some extent the core phyla of treated wastewater (WW-E), but in different shares. This suggests the possible washout of wastewater-related bacteria with activated sludge flocs, which was also supported by the microscopic observations. Compared to Lake 1, in WW-R an increase in all tested parameters was noted: total prokaryotic cell number, average cell volume, prokaryotic biomass and live cell percentage. The presence of Enterococcus spp. antibiotic resistance patterns highlight the importance of human associated microbiome and resistome dissemination via wastewater discharge. Moreover, it can be expected that temperature-related biochemical processes (e.g. nutrient cycling) may be accelerated by the ongoing climate change. Thus, proper wastewater treatment requires locally adapted solutions in increasingly visited and inhabited polar regions. Additionally, microbial community discharged to the environment with the treated wastewater, requires critical attention.

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