Heat below the City – Is temperature a key driver in urban groundwater ecosystems?

Constanze Englisch[‡], Eva Kaminsky[§], Cornelia Steiner[|], Christine Stumpp[§], Gregor Götzl[|], Christian Griebler[‡]

‡ University of Vienna, Vienna, Austria
§ University of Natural Resources and Life Sciences, Vienna, Austria
| Geological Survey, Vienna, Austria

Corresponding author: Constanze Englisch (constanze.englisch@univie.ac.at), Eva Kaminsky (eva.kaminsky@boku.ac.at), Cornelia Steiner (cornelia.steiner@geologie.ac.at), Christine Stumpp (christine.stumpp@boku.ac.at), Gregor Götzl (gregor.goetzl@geologie.ac.at), Christian Griebler (christian.griebler@univie.ac.at)

Abstract

Living in an urban groundwater ecosystem comes with many challenges for its inhabitants. In Central Europe, groundwater fauna has adapted to a dark, cold, and typically energy-poor habitat for thousands of years, making these highly specialised animals susceptible to short-term (years to decades) changes in environmental conditions. In urban areas, many anthropogenic pressures like surface sealing, subsurface infrastructures, organic pollution, or accumulation of toxicants impact the groundwater ecosystem. On top, the urban subsurface is heating up with an enormous speed, characterized by the formation of subsurface urban heat islands. With urban groundwater temperatures continuously increasing way beyond natural background values, a loss of biodiversity and ecosystem functioning with ultimately a deterioration of water quality is predicted. In the current research project 'Heat below the City', we target the urban groundwater ecosystems of the city of Vienna, Austria. 150 groundwater wells distributed all over the city have been sampled twice, in autumn 2021 and spring 2022. Groundwater samples are analysed for a large set of physical-chemical, microbiological and faunistic variables, aiming to identify main drivers of groundwater ecosystem biodiversity and functioning. The focus lies on temperature induced cascading effects that may lead from ecologically intact oxic habitats to anoxic zones lacking fauna with deteriorated water quality. First findings show mean groundwater temperatures in Vienna to be at 14°C, about 3°C above the natural background, with anthropogenic heat sources having a main impact on the distribution and degree of warming. The absence of dissolved oxygen (DO) and NO_3^- as well as the presence of Fe^{2+}, S^{2-} and CH_4 hint at zones of reduced groundwater below the city. First data on physical-chemical conditions, microbiological and faunal communities will be introduced.

Keywords

Groundwater; Warming; Urban; Vienna; Stygofauna

Presenting author

Constanze Englisch

Presented at

International Conference on Subtrerranean Biology

Hosting institution

Institute of Speleology, Romania

Conflicts of interest

I declare a lack of conflict of interest.