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Ecological assessment of water quality in relation to hydrogeology in a shallow urban aquifer: Somesul Mic River aquifer (North-Western, Romania)

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The River Basin Management Plan is the main instrument for the implementation of the Water Framework Directive (2000/60/CE), one of its main requirements being the evaluation and quantification of human impacts on aquatic environments including the groundwater or groundwater dependent ecosystems. The Someş-Tisa basin is the largest hydrographical basin in NW Romania (22,380 km2), containing 15 Quaternary detrital groundwater bodies prone to intensive agricultural and urban industrial use. So far, no studies have addressed the groundwater fauna assemblages and their ecological response to human disturbances and aquifer contamination. Here we investigate a Quaternary shallow detrital aquifer (< 30 m depth) associated with the Someşul Mic River affected by both urban-industrial and agricultural contaminants, aiming to evaluate the sensitivity and structural patterns of groundwater crustaceans communities to aquifer contamination with trace metals (Cr, Mn, Co, Ni, Cu, Zn, Cd, Mo, Pb), As, Se and nitrates.

We conducted a survey in seven monitoring boreholes (1-8 m beneath the surface) through the Quaternary porrous aquifer of the Somesul Mic River on a 10 km long longitudinal transect. Hydrologic and geologic variables (rainfall amount, drainage network density, aquifer and drainage elevation, transmisivity and aquifer porosity) were extracted from previous works and Pearson correlations were calculated for paired variables. Water and faunal sampling was performed on a seasonal basis at one pristine and six impacted sites during 2013. Invertebrates were sampled with a submersible pump by extracting a volume of 50-100 l of water and filtering through a 63 microns planktonic net. Subsequently, 2 l of water was extracted after pumping for compositional analyses of major constituents, trace elements (by ICP-MS) and nutrients.

The results of water geochemical analyses indicate a significant pollutant charge of groundwater with Mn (max. 29.26 μg/l), Ni (16.55 μg/l), Fe (509.74 μg/l), As (3.87 μg/l), Se (5.07 μg/l), sulphates (549.9 μg/l) and nitrates (95.4 mg/l) downstream from industrial and agricultural lands. Only seven taxa, dominated by crustaceans, were found within the stygofaunal communities. Copepod stygoxene species (i.e. Megacyclops viridis Jurine, 1820, Diacyclops languidoides ssp.) accounts for almost 80% of the groundwater crustaceans, being abundant in samples from sites with elevated (94 μg/l) concentration of nitrates (thus indicating a high tolerance to this pollutant). Moreover, these species appear to be tolerant to high content of Cu (8.6 μg/l) and only slightly tolerant to Sr, Co, Ni, Ti and Pb ($r>0.60$; $p>0.05$). Conversely, the stygobites species Parastenocaris sp. (Harpacticoida), Bathynella sp. (Syncarida), Niphargus sp. (Amphipoda) and Ostracoda were rare and limited to boreholes were no significant trace metals contamination was detected, whereas nitrates reach a maximum level of 47.5 μg/l. Crustaceans abundance was linked to high content of total dissolved solids and elements such are Li, Na and Sr; whereas Cs and nitrites were detected to be harmful for crustacean development.

The ecological attributes and sensitivity of styfogauna to contaminants makes them significant bioindicators for evaluating the ecological status of groundwater ecosystems and susceptible to get loss when aquifers quality is affected on long term.