Sources, transport, and eutrophication potential of phosphorus in the catchment of drinking water reservoir Římov, Czech Republic

Josef Hejzlar*, Jakub Borovec, Jiří Jan, Jiří Kopáček

Biology Centre AS CR, Institute of Hydrobiology, Na Sadkach 7, 370 05 Ceske Budejovice,
*hejzlar@hbu.cas.cz

Římov Reservoir is a dimictic, deep-valley reservoir (volume, 34 10^6 m^3; surface area, 2,1 km^2; max. depth, 43 m; mean water residence time, 0.25 yr) in an upland area of South Bohemia (48.833N, 14.667E). Its water quality suffers from symptoms of eutrophication caused by excessive loads of phosphorus (P). Land use of the catchment (area, 489 km^2) include forestry (51%), agriculture (arable land, 22%; grassland, 24%), urbanization (2%; mean population density, 35 persons per km^2), and fish ponds (1%). The aim of our study was to investigate the point and diffuse P sources in the catchment, determine the composition of dissolved and particulate P forms in the particular sources, and evaluate the amount and forms of P that were permanently retained in the reservoir bottom sediments by its major binding counterparts, i.e. Fe and Al hydroxides.

The study evidenced that judging the eutrophication potential based on the total P export from particular sources can lead to biased results. Namely, the point source discharges of municipal wastewaters and the fish pond effluents represented only ca 22 and 3% of the total catchment P sources, respectively, nevertheless, they overweighed all other sources in the eutrophication effect as they delivered most of P into the reservoir in bioavailable forms (orthophosphate and/or phytoplankton biomass) and also were the primary cause of increased concentrations of P in the reservoir inflow during the summer period. These two source types also showed a low (Fe+Al)/P molar ratio (less than 5) while the runoff from forest and agriculture areas had this ratio above 15, which indicates that P from the municipal wastewaters and fish pond effluents might be more easily recycled in the reservoir aquatic ecosystem without being entrapped in particles and made unavailable by combining with these metals. Also the sediment particles in the forest and farmland streams showed low phosphorus saturation index (PSI) values (less than 10%) while the particles in streams loaded with municipal wastewaters had the PSI values much larger (over 30%). The analysis of P fractions in a dated sediment core from the reservoir lacustrine part showed a higher P concentrations and PSI values compared to particles delivered into the reservoir from the catchment with the inflow, indicating stable and permanent retention of P in the reservoir bottom deposits.

In conclusion, this study demonstrated that the improvement of eutrophication problems should be directed mainly to more efficient purification of P from municipal wastewaters and to the reduction of P concentration in fish pond effluents.