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Effects of invasive ecosystem engineers on the fate of trace organic pollutants during bank filtration

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Invasive species and trace organic pollutants are increasingly important stressors for freshwater ecosystems. Invasive species can act as ecosystem engineers, directly or indirectly controlling resource availability of their habitat and thereby also affecting the fate of trace organic pollutants. Trace organic pollutants of concern are highly prescribed pharmaceutical compounds and personal care products since they are polar and stable in the environment. They are only transformed within the oxic zone during induced bank filtration. Trace organic pollutants can reach surface waters via treated sewage effluents. Bank filtration is increasingly applied to meet the high drinking water demands, e.g. in the German capital Berlin where approximately 60% of the drinking water is supplied by bank filtration. Trace organic pollutants can potentially contaminate drinking water produced by bank filtration if their degradation and retention during sediment passage is insufficient. Research concerning the fate of trace organic pollutants during bank filtration usually focused on the influence of abiotic parameters, while the potential impact of invasive ecosystem engineers is unknown. In our study, we aim at analysing how two major invasive ecosystem engineers of temperate freshwater ecosystems in Europe, the Quagga mussel (Dreissena rostriformis bugensis) and Nuttall's waterweed (Elodea nuttallii), can alter the fate of trace organic pollutants by changing the redox status at the sediment-water interface. In Berlin, all lakes used for bank filtration (Müggelsee, Lake Tegel, Wannsee) were recently invaded by Quagga mussels and Nuttalls's waterweed. While Lake Müggelsee is largely unimpacted by organic trace pollutants and can serve as control, Lake Tegel and Wannsee receive significant loading by treated sewage. The influence of Quagga mussels and Nuttall's waterweed on the fate of the following selected trace organic pollutants is tested: valsartan, valsartan acid, oxipurinol, acesulfame, gabapentin, carbamazepine, which are pharmaceuticals and an artificial sweetener. In an extensive column experiment bank filtration of water containing trace organic pollutants is simulated and oxygen, nitrate, sulfate, manganese and iron concentrations are monitored to investigate the influence of redox zonations in the absence/presence of Quagga mussels or Nuttall's waterweed at the sediment-water interface. Different oxygen measuring techniques are applied to guarantee a high resolution at this interface. Based on these data we evaluate the role of invasive ecosystem engineers on the degradation and/or retention of trace organic pollutants.