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Mercury transfer through the food web of the three-spined stickleback (Gasterosteus aculeatus)

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Mercury is considered as one of the top priority chemicals by the WHO and is a pollutant of global concern due to its capacity to travel long distances through the atmosphere. Nowadays, point sources of mercury pollution in Flanders are rare but certain regions are still contaminated as consequence of historical pollution. Microbes can convert inorganic mercury to a methylated form which is biomagnified through the food chain and has strong neurotoxic properties. The actual risk of transfer of environmental mercury to biota is highly dependent on physicochemical properties of the water and sediment since they influence methylation processes and bioavailability. Profound knowledge on the matter of bioavailability remains scarce due to the complexity of mercury speciation and sensitivity of mercury analysis. This study was setup to gain a better understanding of mercury bioavailability and the transfer through the food chain of the three-spined stickleback (Gasterosteus aculeatus). During a preliminary field study within the Scheldt and Maas basin of Flanders, 8 stickleback populations characterized by both high and low muscle mercury content were identified. Subsequently, water-, sediment-, macroinvertebrate- and fish samples were collected and analyzed for total mercury concentration and additional physicochemical properties (water and sediment). Biota-sediment magnification factors (BSMFs) were calculated as a proxy for mercury bioavailability for benthic macroinvertebrates. Differences between populations in terms of bioaccumulation as a consequence of dietary mercury exposure was evaluated via estimated biomagnification factors (BMFs). The total mercury load within one specific river was positively correlated with organic matter content (R= 0.77) and smaller grain sizes (R=0.52), while samples with a higher percentage of sand had less mercury (R = 0.80). Organic matter content (R=0.67), a larger clay (R=0.62) and silt (R =0.57) fraction and higher acid volatile sulfide concentration (R=0.79) in the sediment did decrease the overall bioavailability of mercury for sediment dwelling invertebrates. The BMFs of the low-contaminated populations were close to or even below 1. On the contrary the biomagnification factors of highly polluted populations ranged from 2-4. The observed differences in mercury biomagnification between distinct populations of the same species is an interesting finding and possible explanations are currently being explored.