

ACCUMULATION AND EFFECTS OF PHARMACEUTICALS ON NATIVE FRESHWATER MUSSELS

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Pharmaceuticals are designed with the intent of acting on a biochemical pathway in living organisms. Therefore, it is not surprising that heightened concern was raised when published reports documented the presence of pharmacologically active compounds in surface waters. Though most pharmaceuticals are not likely to accumulate to high concentrations in tissues, they are continually released at low levels and may be exerting effects on non-target aquatic organisms. We measured the occurrence, persistence, and bioaccumulation of select pharmaceuticals, but focusing on fluoxetine, a drug commonly prescribed as an antidepressant, in samples of water, polar organic chemical integrative sampler (POCIS), sediment, and caged freshwater mussels (Family Unionidae) at stream sites upstream, in, and downstream of a municipal wastewater treatment facility. We then assessed the relation of these measured environmental concentrations to reproductive endpoints (release of gametes, parturition of larvae, mantle lure display behavior) in mussels in acute laboratory tests. Mean measured concentrations of fluoxetine in water and POCIS samples were similar within each site and were lowest at an upstream reference site (<limit of detection-2.4 ng/L), greatest in the effluent channel (104 ng/L-119 ng/L), and decreased linearly at 50 m (10.0 ng/L-14.4 ng/L) and 100 m (5.1 ng/L-7.3 ng/L) downstream in the receiving stream. Likewise, mean measured concentrations of fluoxetine in sediment and mussel (*Elliptio complanata*) tissue were greatest in the effluent channel (17.4 ng/g wet weight for sediment and 79.1 ng/g wet weight for mussels). In laboratory tests, fluoxetine significantly induced parturition of nonviable larvae from female *E. complanata* exposed to 300 µg/L ($p = 0.0118$) and 3000 µg/L ($p < 0.0001$) compared to controls. Fluoxetine exposure at 300 µg/L ($p = 0.0075$) and 3000 µg/L ($p = 0.0001$) also resulted in stimulation of mantle flap display behavior in female *Lampsilis fasciola* and *Lampsilis cardium*, respectively. In male *E. complanata*, 3000 µg fluoxetine/L significantly induced release of spermatozeugmata. These results suggest that fluoxetine accumulates in mussel tissue, persists in sediment downstream of known point sources, and has the potential to disrupt several aspects of reproduction in freshwater mussels, a faunal group recognized as one of the most imperiled in the world.

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