Article 83

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Trace Metal Bio-Accumulation in the Aquatic Community of Stormwater Ponds

Stormwater managers have always been concerned that pollutants trapped in stormwater pond sediments could re-enter the aquatic food web. Prior research has demonstrated that trace metals and hydrocarbons are taken up and incorporated into the tissues of wetland plants. Is there also a risk that pond macroinvertebrates can take up metals trapped in pond sediments? Can they ultimately move upward in the food web into the fish and wading birds that feed on them? If so, is the metal bio-accumulation great enough to warrant concern about toxicity? Is it safe to eat fish that are caught from stormwater ponds? Does it make sense to design stormwater ponds to attract wildlife? Two recent studies begin to shed some light on these troubling questions.

Karouna-Reiner conducted comprehensive macroinvertebrate surveys at 18 stormwater ponds and wetlands in suburban Maryland over a one-year period. Most of the ponds were a half-acre to one-acre in size, and most were constructed within five years of the study. All had a permanent pool up to six feet deep; many also contained extensive emergent wetlands. The pond's contributing watersheds were dominated by either commercial, residential or industrial land uses. In addition, Karouna-Reiner selected two constructed ponds that did not receive urban runoff to serve as reference controls. During the course of her year-long study, Karouna-Reiner monitored trends in the pond macro-invertebrate community in the littoral zone and sampled metals in pond water, sediments and macroinvertebrate tissue. In addition, she designed a bioassay system to test for toxicity in a sensitive amphipod, *Hyallela azteca*, exposed to typical stormwater pond sediments over a 10-day period.

In general, the sediment macro-invertebrate community in stormwater ponds was dominated by snails, midges, damselflies, skimmers, backswimmers and various diving and crawling beetles. Although diversity in individual stormwater ponds was quite variable, the pond macro invertebrate community was only slightly degraded in comparison to the reference ponds, according to two biological metrics, and was not different according to two others (abundance and percent chironomids - see Table 1). Statistical analysis also showed that the type of land use has no influence on the diversity of the pond community. Much of the variability in diversity was attributed to differences in wetland coverage and hydrology among the ponds. The stormwater pond macro-invertebrate community was more diverse than those sampled by Galli (1988) and Yousef *et al.* (both of whom concentrated more on the composition of deeper water sediments).

Karouna-Reiner detected copper, lead and zinc, and occasionally cadmium in the tissues of snails, damselflies, and a composite sample of other macro-invertebrates collected from the stormwater ponds (Table 2). While clear bio-accumulation was noted for copper, zinc and cadmium, the metal levels found in sediments and macro-invertebrate were generally within, or reasonably close to those for other unpolluted pond and wetland systems. In addition, the bioassay work did not indicate any acute toxicity for the amphipod, *H. azteca*, that were exposed for 10 days.

Campbell (1995) investigated trace metal levels in sediment and fish tissue in seven stormwater ponds in located in Central Florida. He studied three fish species that had different feeding habits: the bottom-feeding redear sunfish (*Lepomis microlophus*), the predatory

Table 1: Comparison of Macro-Invertebrate Diversity in Stormwater and Reference Ponds (Karouna-Reiner, 1995)

Pond Diversity Metric Mean of ponds sampled	Stormwater Ponds N = 18	Reference Ponds N = 2
Taxa Richness	15.8	18.6
EPOT *	5.17	6.33
Abundance	247.1	229.72
Percent chironomids	10 %	15.5 %

* taxa richness of Ephemeroptera, Plecopetera, Odonata and Trichoptera