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Station

Zebra Mussel Research Technical Notes

Section 1 — Environmental Testing Technical Note ZMR-1-27

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Sediment Toxicity and Bioaccumulation of Contaminants in the Zebra Mussel at Times Beach, Buffalo, New York

Background

The spread of the zebra mussel (*Dreissena polymorpha*) in North America raises many environmental concerns. Among these is the potential for contaminant bioaccumulation by these freshwater mussels. Zebra mussels have a relatively high bioaccumulation potential. Combined with their high filtration rate, this potential could prove to be an environmental hazard as zebra mussels build up large populations in contaminated areas (Reeders and Bij de Vaate 1992, Fisher and others 1993). This could be of concern if zebra mussels effectively accumulate and concentrate contaminants, resulting in contaminant bioaccumulation and biomagnification through the food web.

Additional information

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Approach

The Zebra Mussel Research Program is funding an ongoing study to determine zebra mussel bioaccumulation potential. The study consists of an active biomonitoring study, utilizing the zebra mussel as a bioindicator. The site is the Times Beach confined disposal facility (CDF) located in Buffalo, NY (Figure 1), as it is an area of documented contamination (Marquenie and others 1990, Stafford and others 1991).

In summer 1993, toxicity tests and chemical evaluations were performed on Times Beach water and sediment as predictive measures to determine ecosystem stress, contaminant concentrations, and bioavailability of contaminants (Burton and others 1987, Swartz and others 1990, American Society for Testing and Materials 1991).

In fall 1993, zebra mussels were collected from the Black Rock Lock, Buffalo District, and placed at four stations in the CDF. At each station, mussels were placed both in the water column and at the sediment level (Figure 2). Mussels were collected on Days 19 and 34 of the study. Tissue analyses are being performed by the WES Environmental Chemistry Branch to detect polycyclic

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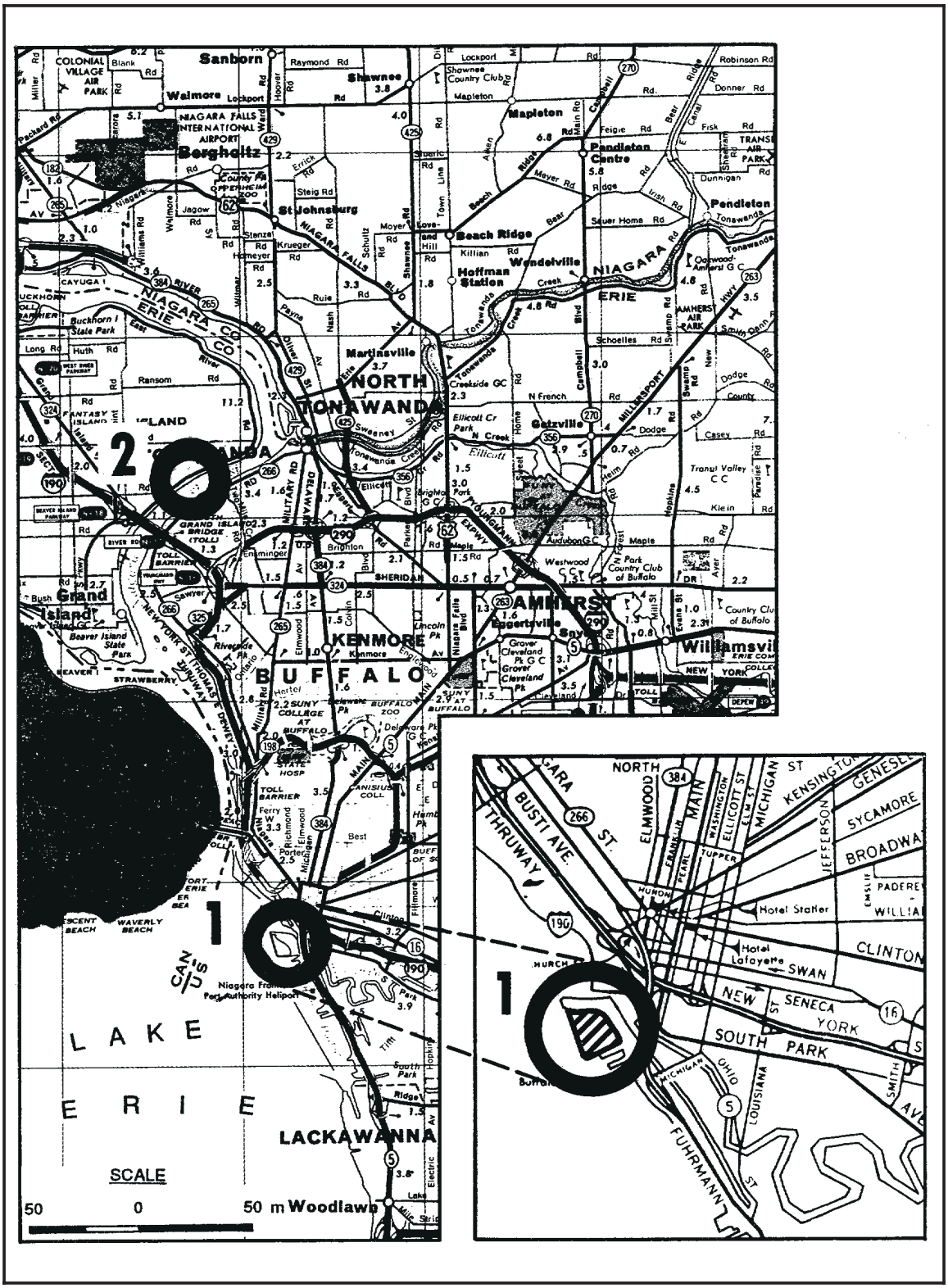

Figure 1. Location of Times Beach confined disposal facility (circle 1) and the selected reference site, Grand Island (circle 2)

aromatic hydrocarbons (PAHs), polychorinated biphenyls (PCBs), and metals (arsenic, cadmium, chromium, lead, mercury, selenium, silver and barium).

Results Chemical evaluation of sediment samples indicated significant levels of metals, PAHs, and PCBs in the soil. PAHs, PCBs, and metals were all found to be below detection limits in the water samples. Whole sediment (Table 1) and elutriate toxicity tests using the cladoceran *Daphnia magna* showed evidence of contaminant bioavailability at the sediment-water interface but not in the water column (Table 2). The majority of the mussels appeared to be alive at the end of the 30-day in situ study. Tissue results are still pending.

Results from the PAH analyses on mussel tissues collected after 30 days at Station TB10 indicate that zebra mussels can effectively accumulate some PAHs in their tissues (Table 2). Mussels placed in the water column (Upper Tissue) appear to accumulate more efficiently than those placed at the sediment level (Lower Tissue). This will be determined statistically when more samples have been processed.

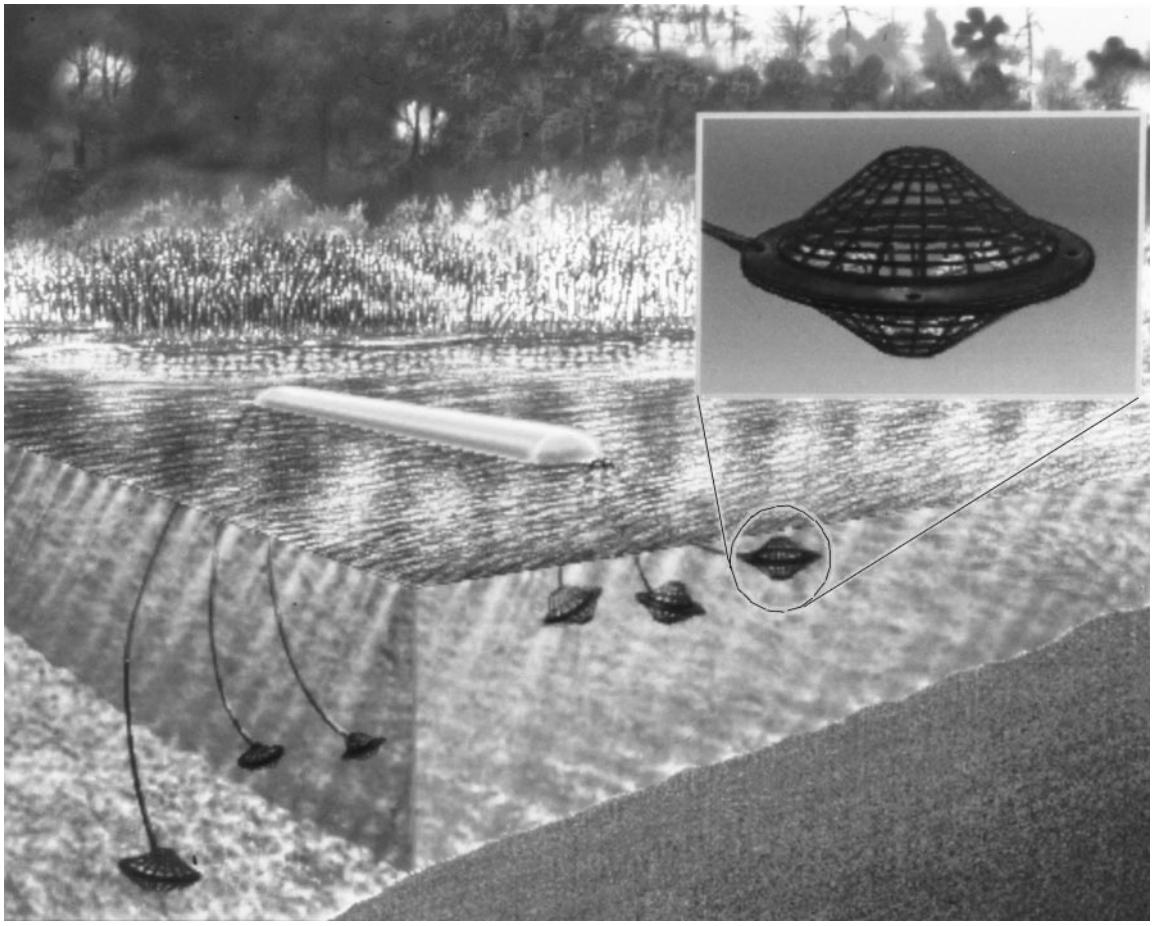

Figure 2. Artist illustration of mussel placement at Times Beach confined disposal facility

Table 1. Results of 10-Day Whole Sediment *Daphnia magna* Toxicity Test (Range in Parentheses)

Site	Percent Survival	Mean Reproduction
Reference	82 (80-90)	82.8 (73-113)
TBP-1	6 (0-15)[1]	3.4 (0-10)[1]
TBP-2	7 (0-15)[1]	9.0 (0-19)[1]
TBP-3	1 (0-5)[1]	2.8 (0-9)[1]
TBP-4	7 (0-20)[1]	1.6 (0-4)[1]

[1]Indicates significant difference from the control.

Table 2. Concentrations of Selected PAHs (mg/kg) in Samples from Site TB10 (Wet Weight)

	Water	Sediment	Upper Tissue	Lower Tissue
Fluoranthene	<0.010	82	2.49	1.84
Pyrene	<0.010	57	2.29	1.59
Chrysene	<0.010	31	1.33	1.29
Benzo(a)Anthracene	<0.010	28	1.06	0.92
Phenanthrene	<0.010	130	1.27	<0.66

Conclusion

These preliminary results indicate the potential for a zebra mussel- induced transfer of contaminants from the sediment into the zebra mussel tissue. A potential concern is the transfer of contaminants from the zebra mussel through the food web.

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