

Accumulation of Contaminant Metals in the Amphipod *Diporeia* spp. in Western Lake Ontario

Ki-Hoon Song and Vincent T. Breslin*

Waste Reduction and Management Institute
Marine Sciences Research Center
SUNY at Stony Brook
Stony Brook, New York 11794-5000

ABSTRACT. Sediment and amphipods (*Diporeia* spp.) were collected in areas in western Lake Ontario suspected of containing a range of sediment metal contents. The total metal contents (Al, As, Cd, Cr, Cu, Ni, Fe, V, and Zn) of depurated *Diporeia* tissues were measured and compared to the total metal contents of the surrounding sediment. The fractional bioavailability of As, Cu, Fe, and Zn was determined in those same sediments using a sequential chemical extraction (SCE) procedure and correlated with depurated *Diporeia* tissue metal contents. Results of these analyses were then used to assess the ability of *Diporeia* to accumulate sediment metal contamination. A comparison of metal biota-sediment accumulation factors (BSAFs) and sediment metal enrichment factors (EFs) for each metal yielded separate metal groups showing different behavior for tissue accumulation. Aluminum, Cr, Fe, Ni, and V were not enriched in the sediments and were not accumulated in *Diporeia* tissues, while As, Cd, Cu, and Zn were enriched in the sediments and accumulated in *Diporeia* tissues. SCE results showed that Cu (3.2 to 8.4 %) and Zn (13 to 19 %) contents in the easily extractable sediment fractions ($MgCl_2$ and Na-acetate) were significantly correlated with Cu ($r = 0.86$; $P < 0.01$) and Zn ($r = 0.69$; $P < 0.05$) contents in depurated *Diporeia* tissue. In addition, Cu and Zn in *Diporeia* tissues are also correlated to the total sediment metal content for each respective metal (Cu: $r = 0.67$, $P < 0.05$; Zn: $r = 0.66$, $P < 0.05$). The high BSAFs for Cu and Zn, in combination with the association of tissue metal contents with easily extracted sediment metal fractions, suggest that *Diporeia* may be a potential bioindicator for Cu and Zn contamination in sediments.

INDEX WORDS: Lake Ontario, *Diporeia* spp., copper, zinc, sediment.

INTRODUCTION

Anthropogenic activities have resulted in elevated concentrations of contaminant metals in the sediments of Lake Ontario (Kemp and Thomas 1976, Mudroch 1983, Mayer and Manning 1991). Metal contamination, and its effect on the surrounding environment, can be estimated from an investigation of sediment and benthic organisms (Luoma 1995). Biomonitoring has been used to establish the temporal and spatial variation in sediment metals in aquatic systems (Hare and Campbell 1992, Moore *et al.* 1991). In particular, amphipod species have been used as indicators for the biological availability and accumulation of trace metals in both marine and freshwater sediments (Borgmann and Norwood 1995, Plénet 1995, Rainbow *et al.* 1989). The freshwater amphipods *Gammaridae* (Zauke 1982), *Gam-*

marus fossarum (Plénet 1995), and *Gammarus fasciatus* (Amyot and Pinel-Alloul 1994, Amyot *et al.* 1996) have been extensively studied as bioindicators for metal contamination in sediments. In contrast, the trace metal content and potential accumulation of metals in the freshwater amphipod *Diporeia* spp. have not been widely studied.

The amphipod *Diporeia* spp. is one of the most abundant benthic macrofauna in the Great Lakes and other northern American lakes. *Diporeia* dwells at a water depth range of about 30 to greater than 100 m and is present at the highest density (1,000 to 7,000 ind. m^{-2}) at depths ranging from 40 to 70 m in Lake Ontario (Winnell and White 1984). *Diporeia* may be an important link in the trophic transfer of metals in the Great Lakes. *Diporeia* is an important food for planktivorous alewife (*Alosa pseudoharengus*), smelt (*Osmerus mordax*), sculpins (*Cottus* spp.), bloater (*Coregonus hoyi*), young lake trout

*Corresponding author. E-mail: vbreslin@notes.cc.sunysb.edu

