Effects of Multiple Heavy Metals on Estuarine Communities

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Frontispiece

The rolling mill and barrels that were used to produce metal-spiked sediments.

Abstract

Aquatic ecosystems are threatened by various natural and anthropogenic stressors. Their simultaneous effects can result in additive or complex non-additive effects. In the region of Auckland, New Zealand, the primary sediment contaminants of concern include stormwater-derived copper (Cu), lead (Pb) and zinc (Zn). The simultaneous effects of these metals on estuarine infauna were assessed through field and laboratory experiments. In the field, Cu, Zn and a mixture of Cu, Pb and Zn negatively affected the colonisation of infauna. In the laboratory, the survival rate of the deposit feeding bivalve *Macomona liliana* was reduced by Cu and Zn, and the combined effects of these metals were cumulative. The effects of Pb, however, were not evident.

A second field experiment explored the nature of the simultaneous effects of Cu and Zn on colonisation. Results depended on the particular response variable being examined. Additive effects were detected for the mean log abundances of the polychaetes *Prionospio* sp. and *Scoloplos cylindifer*, for species richness and for the multivariate response of the community as a whole. In contrast, antagonistic effects were detected for the mean log abundances of total infauna and the polychaete *Heteromastus* sp.

Sub-lethal impacts can result in longer-term effects on benthic communities, including through bioaccumulation of metals. A second laboratory experiment measured bioaccumulation of heavy metals in the bivalves, *M. liliana* and *Austrovenus stutchburyi*. Both species accumulated Pb and Zn, but bioaccumulation of Cu was slight in *A. stutchburyi* and not evident at all in *M. liliana*. The presence of Pb increased the bioavailability of Cu and/or Zn and, therefore, uptake of these metals by the bivalves in some cases.

These results clearly showed direct negative and cumulative effects of Cu and Zn and potential indirect effects of Pb on estuarine infauna, highlighting the importance of considering the co-occurrence of multiple metals when assessing their ecological impacts. Manipulative field experiments need to be combined with laboratory ecotoxicological studies in order to unravel the combined and interactive effects of multiple metals so that their potential impacts on estuarine communities may be accurately modelled and predicted.

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