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The effect of true water hardness and alkalinity on the toxicity of Cu and U to two tropical Australian freshwater organisms

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Contents

Tables

Figures

Summary

The Australian and New Zealand water quality guidelines aim to supplement and modify existing criteria, which are mostly based on Northern Hemisphere toxicity data, with information relevant to Southern Hemisphere ecosystems as it becomes available. In the wet-dry tropics of Australia, copper (Cu) and uranium (U) are metals of particular concern, due to mining activities. Although the toxicity of Cu and U to tropical freshwater species has previously been characterised, the influence of physico-chemical parameters on toxicity has not been defined. In contrast, temperate freshwater studies have investigated the effects of various physico-chemical parameters on Cu toxicity and, to a limited extent, U toxicity. The reported results are, however, contradictory. Thus, it is recognised that the development of a model based on key water quality variables would enhance the capacity to predict the potential site-specific impacts of Cu and U in tropical ecosystems.

This research aimed to separate the effects of true water hardness (6.6, 165 and 330 mg L^{-1} as $CaCO_3$) and alkalinity (4.0 and 102 mg $CaCO_3$ L^{-1}), at a constant pH (6.0), on the toxicity of Cu and U to *Hydra viridissima* (green hydra, population growth) and *Mogurnda mogurnda* (purple-spotted gudgeon, sac-fry survival). The effect of water hardness (ie Ca and Mg concentration) varied depending on the metal and test organism. A 50-fold increase in hardness resulted in a 2-fold decrease in the toxicity of Cu to *M. mogurnda*, but had no effect on U toxicity. The opposite was observed for *H. viridissima*, where increased hardness had no effect on Cu toxicity, but it decreased U toxicity by approximately 2-fold. A 25-fold increase in alkalinity (ie carbonate concentration) had no effect on Cu toxicity to *H. viridissima*, but decreased U toxicity by approximately 10%. Gaining a fundamental understanding of the interactions between physico-chemical parameters and metals, and the subsequent potential impacts on freshwater ecosystems is an essential aspect of site-specific environmental risk assessment and water quality guideline derivation.

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