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## **Extent and magnitude of copper contamination in marinas of the San Diego region, California, USA**

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### **ABSTRACT**

Marinas are areas of special water quality concern because of the potential for pollutant accumulation within their protected waters. Perhaps the largest contaminant source to marinas is antifouling paints that leach copper to prevent the growth of encrusting organisms on vessel bottoms. Very little monitoring of marinas is typically conducted despite the potential environmental risk, particularly in the San Diego region of California, USA where as many as 17,000 recreational vessels are berthed. The objective of this study was twofold: (1) determine the extent and magnitude of dissolved copper concentrations in marinas throughout the San Diego region, and (2) determine if elevated copper concentrations in marinas of the San Diego region are resulting in adverse biological impacts. A probabilistic study design was used to sample water column copper concentrations and toxicity (using *Mytilus galloprovincialis*) at 30 stations. Results indicated that exceedence of state water quality objectives was widespread (86% of marina area), but that toxicity was much less prevalent (21% of marina area). Toxicity identification evaluations (TIEs) conducted at the most toxic sites indicated that toxicity was largely due to trace metals, most likely copper. Toxicity was reduced using TIE treatments that chelated trace metals such as cation exchange column, ethylenediaminetetraacetic acid (EDTA), and sodium thiosulfate (STS). Moreover, increasing dissolved copper concentrations correlated with increasing toxicity and these copper concentrations were high enough to account for virtually all of the observed toxicity.

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