

Probabilistic Ecological Risk Assessment of Heavy Metals in Korean Rivers Using Site-Specific Organisms

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Abstract

Heavy metals in aquatic environment have been a concern because they could cause adverse effects on the ecosystem even at low concentrations. The present study estimates how the concentrations of heavy metals (copper, cadmium, lead, and zinc) in the four major rivers in Korea were risky at aquatic ecosystems. In order to assess the ecological sensitivity caused by the substances, the species sensitivity distributions (SSDs) which statistically simulate the variation of toxicity of different organisms for the substances are developed. Though the constitution of SSD is recommended including toxicity data from inhabited species, the toxicity data in Korea is limited so that the toxicity data from literatures tested using similar species living in Korea and published in worldwide are adopted to develop SSD herein in terms of species-for-species matching method. In addition, the environmental concentration distributions (ECDs) are developed by statistically simulating the range of concentration of heavy metals in the rivers based on the results of nation-wide monitoring for 10 years 2007 through 2016. Probabilistic ecological risk assessment that both distributions are compared consequently were conducted and the risks of the ecosystem posed by the heavy metals in Korean rivers were observed. As a result, any ecological risk of cadmium in the aquatic environment was not expected because most concentrations of the substance in the rivers showed much lower than the technically identifiable concentrations. Copper and zinc in the rivers could generate the risk at a very low probability. Besides, most aquatic organisms evaluated in the present study are insensitive to lead at various detected concentrations, indicating no ecological risk. Consequently, these results of risk assessment in rivers may be applied for national water quality criteria protecting aquatic life with considering the technical level of treatments.