
On the likelihood of ecological risks from microplastics in the Laurentian Great Lakes

Albert Koelmans^{*1}, Paula Redondo-Hasselerharm , Hazimah Mohamed Nor , and Todd Gouin

¹Aquatic Ecology and Water Quality Management, Department of Environmental Science, Wageningen University Research Centre – P.O. Box 47, 6700 AA Wageningen, Netherlands

Abstract

The Laurentian Great Lakes represent important and iconic ecosystems. Among other anthropogenic stressors, microplastic pollution has become a major problem in these lakes. There is a need for policy development, however, assessing the risks of microplastics is complicated due to poor quality and incompatibility of exposure and effect data for microplastics with different properties. Here we provide a probabilistic risk assessment for Great Lakes sediments and surface waters that corrects for the typical mismatch between exposure and effect data, accounts for variability due to sample volume when using trawl samples, for the random spatiotemporal variability of exposure data, for uncertainty in data quality (QA/QC), in the slope of the power law used to rescale the data, and in the HC5 threshold effect concentration obtained from SSDs. A specific, new SSD was developed for freshwater ecosystems. We rank the lakes in order of the increasing likelihood of risks from microplastics, for pelagic and benthic exposures. A lake-wide risk, i.e. where each location exceeds the risk limit, is not found for any of the lakes. However, the probability of a risk from food dilution occurring in parts of the lakes is 13-15% of the benthic exposures in Lakes Erie and Huron, and 8.3-10.3% of the pelagic exposures in Lake Michigan, Lake Huron, Lake Superior, and Lake Erie, and 24% in Lake Ontario.

Keywords: risk assessment, microplastic, Great Lakes, sediment, water column

^{*}Speaker