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Detection limits can influence the interpretation of pesticide monitoring data in Canadian surface waters.

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Abstract

Water quality monitoring programs rely on residue data that are frequently left censored, due to some observations occurring below the Method Detection Limit (MDL). Our objective was to determine the influence the MDL has on the interpretation of pesticide residues in surface waters. Water samples from tributaries in southern and central Ontario were collected by Environment Canada from 2003 to 2008 and were analyzed for 27 pesticides, with MDLs that averaged 7.02ng(-1)L (range 0.39-25.1ng(-1)L). We then simulated MDLs ranging from 25 to 1700ng(-1)L, to determine the impact this would have on the reporting of pesticide concentrations and detections. The mean number of pesticides detected simultaneously declined with increasing, i.e. less sensitive MDLs, from 5.02 pesticides (native MDL) to 0.08 pesticides detected (MDL<1700ng(-1)L). We compared the proportion of sites where pesticides were detected in surface waters under five MDL scenarios for 13 selected pesticides. The proportions decreased sharply with increasing MDLs. We calculated detection probabilities in an effort to compensate for higher MDLs using maximum likelihood; while adjusting for detection probabilities generally improved estimates of the presence of pesticides, as the MDLs increased the ability to compensate for detection probabilities deteriorated and became unviable at high MDLs. Depending on the method of substitution for observations below MDL (replacement with $\frac{1}{2}\times$ or $0\times$ MDL), the mean and median pesticide residues became increasingly over- and underestimated, respectively, at higher MDLs. Although monitoring programs that are focused on exceedences of water quality guidelines may not require low MDLs, the achievable goals of monitoring programs oriented towards other ecological and toxicological objectives may be limited by higher MDLs.

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