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EARTHWORMS -- INDICATORS OF ORGANIC ANTHROPOGENIC WASTE CONTAMINATION IN TERRESTRIAL ENVIRONMENTS

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ABSTRACT: Earthworms are a predominant consumer of organic matter in soil environments. Land application of organic-rich biosolids produced during wastewater treatment and animal manure as a fertilizer source for plants is common practice in the United States. Biosolids and manure are known to contain a complex mixture of numerous organic anthropogenic waste indicator (AWI) compounds, including detergent metabolites, pharmaceuticals, synthetic fragrances, and others, with concentrations generally in parts per trillion to parts per million. Thus, a field study was conducted to determine if earthworms act as sentinel organisms for detecting the presence of pharmaceuticals and other AWIs in soil environments. The field sites consisted of agricultural soils in the Midwestern United States, including a no-till soybean field receiving biosolid amendment for the first time, and sites in the Western United States with an extended history (20+ years) of biosolid amendment. These results indicate that once land applied, select AWIs can transfer from biosolids or manure and bioaccumulate in earthworm tissue. The transfer of AWIs into earthworm tissue can be observed in as short as 30 days following the first application of waste material; including pharmaceuticals, synthetic fragrances, detergent metabolites, disinfectants, and plasticizers. In many instances, the AWIs detected in earthworm tissue samples were below the limit of detection in the corresponding soil samples from which earthworms were collected. Therefore, by virtue of their ability to bioaccumulate, earthworms may serve as a valuable tool for detecting terrestrial contamination of some classes of AWIs . Given that earthworms represent a substantial fraction of biomass in many terrestrial environments and are a primary consumer of soil organic matter, they may serve as a pathway for introducing AWIs into other components of the food web raising additional ecological concerns.

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