

Plastic debris and persistent and bioaccumulating toxic contaminants in the Tijuana River Estuary: *A case study in estuarine contaminated sediment management*

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Abstract

Microplastics have been found to hyperaccumulate persistent and bioaccumulating toxins (PBTs), acting as an exposure media to birds, fish and macroinvertebrates. We compared chemical concentrations between sediments and co-located plastic fragments at the Tijuana River Estuarine Natural Resource Reserve.

Methods

We separated plastic debris pieces from sediments using standard size soil sieves. We estimated plastic quantities in sediment samples by measuring plastic mass based on sediment mass processed through sieves. We analyzed sediments and plastic fragments for PBTs using a Gas Chromatography/High Resolution Mass Spectroscopy (GC/HRMS) at Axys Analytical Services.

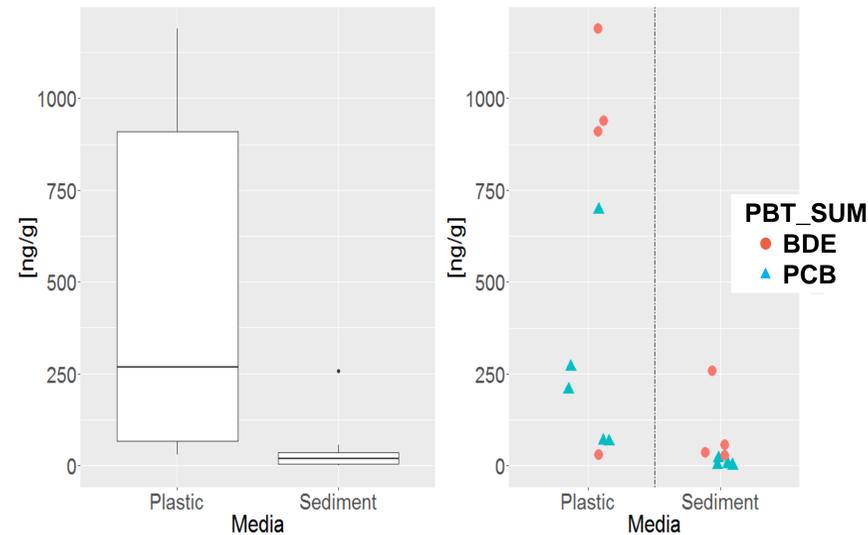
Location Description	Mass of Sediment Processed (kg)	Mass of Plastic Collected (g)	%Mass plastic	mass plastic/volume sediment (g/L)
Beach background	22.2	2.3	0.010%	0.14
Upper basin	9.7	11.5	0.118%	1.35
Staging Pad sorted pile	9.7	3.4	0.035%	0.40
Staging Pad unsorted pile	10.8	2.9	0.027%	0.34
IBWC excavated pile	13.7	3.4	0.025%	0.30

Findings

Concentrations of PBTs on plastics far exceeded concentrations in sediments from the same sample location. In one plastic sample, a maximum concentration of over 213,966 ng/g BDE was detected, comprised predominantly of congener 209 (>70%).



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Box and scatter plots of PCB and BDE sums in plastic vs. sediment samples.

A “back-of-the-envelope” calculation using an estimate of 40 metric tons of plastic and a median PCB sum of 200 ng/g yields a total PCB load of up to 8 kg per 100,000 cubic meters of sediment. PBT risk assessments performed on sediments may be confounded by the presence of contaminated microplastic media significantly impacting sediment contaminant risk assessment.



Overview of Tijuana Estuary sedimentation basins, near Imperial Beach, CA and the City of Tijuana, MX



(top) view of lower basin upstream (bottom) sample collection activities upstream of upper basin

Recommendations

Managers may be challenged by the presence of plastic debris as it may bear a significant portion of PBT exposure in estuarine sediments. It is likely that other estuarine regions have similar problems. This case study will inform management of other areas facing similar waste issues.