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Contamination of Buried Plastic Marine Litter on Sandy Beaches in the West Coast of Sri Lanka

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Abstract

Sandy beaches act as an interface between land and sea and can serve as an indicator of the level of contamination in the marine environment. The beach can be both a source and a sink for marine litter contamination. Long-term accumulation of buried plastic marine litter (BPML) can produce microplastics by mechanical destruction and/or UV-degradation. This study aims to investigate the contamination and distribution of BPML in the Crow Island (CR) and Wattala (WT) beach areas during the Northeast monsoon. CR had a significantly higher anthropogenic load compared to WT beach. BPML (>5 mm) was determined in 12 quadrats (0.5×0.5 m) per beach area. From each quadrat, sand samples (2 sand samples per quadrat) were obtained in shallow and deep layers of the beach (surface to 3 cm, and 3 cm to 6 cm respectively). The fraction of the mass of coarser sand was determined to identify the relationship between the coarseness of the sand sample and BPML contamination. Coarseness of the sample was determined by removing fine sand using a 1 mm sieve. Accumulation patterns of BPML were analysed between the storm line and sand dune. On average, 21 items/kg Dry Weight (DW) and 7 items/kg DW were collected from sand samples from shallow and deep layers of the CR beach, respectively. In contrast, the WT beach area had almost no plastic pieces on average in a kilogram of dried sand samples collected from both depths. Out of the 24 sand samples collected from the WT beach, only 7 of them contained plastic pieces. Characterization of the polymers of the BPML was carried out using ATR-FTIR. Shallow and deep layers of sample from CR beach contained Polyethylene (10 items/kg DW and 3 items/kg DW respectively) and polyethylene terephthalate (5 items/kg DW and 2 items/ kg DW respectively) type BPML in high amounts. BPML accumulation on the CR beach was significantly affected by the depth of the beach and distance from the storm line ($p < 0.05$, One-way ANOVA). High contamination by BPML is found to be associated with coarser sands. The average fraction of coarser sand for samples collected from the shallow and deep layers of the CR beach near the storm line is 17.4% and 26.1%, respectively, which indicates high contamination of plastics in the deep layer compared to the shallow layer. In contrast, the shallow layer contained a high percentage of coarse sand (5.3%) compared to the deep layer (3.7%) near the sand dune or vegetation. Findings indicate encouraging mitigatory measures to clean up marine litter focusing on both shallow and deep layers is recommended.

Keywords: West Coast, Buried plastic marine litter, ATR-FTIR, Coarser sands