Proposed Threshold for Microplastic Presence on Sandy Beaches Perceived as "Clean"

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ABSTRACT

Microplastics (MPs) adsorb hazardous substances and are ingested by a wide range of organisms; therefore, indicators for managing their environmental concentrations are needed. Ideally, threshold values should be based on health impacts. However, the diversity of MPs and the complexity of their environmental behavior make it difficult to establish unified environmental concentration standards. In this study, we propose a threshold for the presence of MPs on sandy beaches based on "visual cleanliness," defined as the amount of MPs that people find psychologically unacceptable. Three types of MPs were used: white polypropylene (PP), blue PP, and white polystyrene (PS; expanded polystyrene). For defining a narrow-range cleanliness threshold, volume concentration was more appropriate than mass concentration. White particles were expected to be less noticeable because they tend to blend with white shell fragments, which are ubiquitous on beaches. In contrast, blue particles were anticipated to be less acceptable due to their scarcity. However, we observed no discernible difference in unacceptability between white and blue plastic particles. The threshold, defined as the volume concentration at which half of the respondents deemed MPs psychologically unacceptable, ranged from 1 to 2 cm3-MPs/m2-sand. Gender, age, travel time to the beach, and frequency of beach visits did not influence unacceptability. Strong concern regarding marine plastic pollution and experience in cleaning public spaces were associated with reduced tolerance for MP contamination on beaches.

Keywords: Microplastic/ Sandy beach/ Cleanliness threshold/ Psychological acceptability