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Textile waste and microplastic induce activity and development of unique hydrocarbon-degrading marine bacterial communities

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Abstract:

Biofilm-forming microbial communities on plastics and textile fibers are of growing interest since they have potential to contribute to disease outbreaks and material biodegradability in the environment. Knowledge on microbial colonization of pollutants in the marine realm is expanding, but metabolic responses during substrate colonization remains poorly understood. Here, we assess the metabolic response in marine microbial communities to three different micropollutants, virgin high-density polyethylene (HDPE) microbeads, polysorbate-20 (Tween), and textile fibers. Intertidal textile fibers, mainly cotton, virgin HDPE, and Tween induced variable levels of microbial growth, respiration, and community assembly in controlled microcosm experiments. RAMAN characterization of the chemical composition of the textile waste fibers and high-throughput DNA sequencing data shows the increased metabolic stimulation and biodegradation is translated into selection processes ultimately manifested in different communities colonizing the different micropollutant substrates. The composition of the bacterial communities colonizing the substrates were significantly altered by micropollutant substrate type and light conditions. Bacterial taxa, closely related to the well-known hydrocarbonoclastic bacteria *Kordiimonas* spp. and *Alcanivorax* spp., were enriched in the presence of textile-waste. The findings demonstrate an increased metabolic response by marine hydrocarbon-degrading bacterial taxa in the presence of microplastics and textile waste, highlighting their biodegradation potential. The metabolic stimulation by the micropollutants was increased in the presence of light, possibly due to photochemical dissolution of the plastic into smaller bioavailable compounds. Our results suggest that the development and increased activity of these unique microbial communities likely play a role in the bioremediation of the relatively long lived textile and microplastic pollutants in marine habitats.

Keywords: microplastic, fiber, hydrocarbon-degrading bacteria, microbial community, pollution, biofilm formation