Experimental Assessment of Biota Removal during Plastic Collection by Plastic Clean-up Mechanisms

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Abstract

Currently, the UN Environment Assembly is working towards an international and legally binding treaty to mitigate plastic pollution, as this has become a global issue of concern. Plastic clean-up technologies, with multiple operational mechanisms, have been developed and deployed to collect legacy litter. However, these technologies may also collect floating biota, potentially leading to unwanted environmental effects. In the field, different parameters (e.g., hydrological conditions) may influence the probabilities of plastic/biota removal. However, currently, there is a lack of knowledge in this field. We aimed to experimentally assess the effect of individual parameters (e.g., plastic traits, flow velocity) on biota removal during plastic collection by two non-commercial, generic clean-up mechanisms: floating booms coupled with a wheel and a curtain of air bubbles, custom-built to fit the 1-meter width of the experimental flume. No effect was observed on biota removed interacting with different plastic traits (foams, films, bottles, and a mix of the three items) for the floating booms-wheel (pKruskal-Wallis=0.15) and the curtain of air bubbles (pKruskal-Wallis=0.4). Higher flow velocity (0.3 m/s) resulted in higher percentages of biota and plastics caught (35% biota and 44% plastic for the floating booms-wheel and 94% biota and 86% plastic for the curtain of air bubbles) compared to 0.1 m/s (27% biota and 35% plastic for the floating booms-wheel and 67% biota and 61% plastic for the curtain of air bubbles). Our results suggest that the interaction with different plastic traits might not directly influence biota removal, but flow velocity should be considered when deploying a clean-up technology. Empirical studies such as ours provide a better understanding of the effect of different environmental and litter-intrinsic parameters on biota removal, which can be used to parameterize ecological models. We recommend field studies to investigate further the effect of multiple parameters on biota collection in real scenarios.

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