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Transport and trapping in complex aquatic canopies: how do coral reefs act as sinks for microplastics?

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The "missing plastic" phenomenon remains, whereby the transport and ultimate fate of microplastics in aquatic environments is mostly unknown. Marine plastic pollution mainly originates from terrestrial sources and upon reaching coastal zones interacts with nearshore ecosystems. Coral reefs in coastal areas are likely exposed to microplastics, especially shallow reefs at low tides, yet the interactions between microplastics and corals are largely unexplored. Reefs can form extremely complex canopies that can trap sediment, and likely act as a sink for microplastic pollution through serval ways: acting as a physical barrier, modifying turbulence and depositional processes, or through incorporation within coral tissue and skeletons. Given reefs form the foundation of highly biodiverse ecosystems, the entrapment of microplastics by coral would possibly increase ingestion by, and physiological damage to, corals and other reef organisms. The broader ecological impact may be considerable, as well as the repercussions for associated ecosystems services for hundreds of millions of people. Furthermore, the impacts of climate change and rising sea temperatures may be accentuated. Despite the growing concern of these consequences and field measurements revealing accumulation in a variety of aquatic canopies, the transport and dispositional processes that drive microplastic trapping in coral canopies is barely understood.

Here, we investigated for the first time the prevalence of microplastic retention by branching coral canopies in a hydraulic flume under several unidirectional flow conditions. Coral colonies were created using 3D-printed models of staghorn coral, *Acropora genus,* an important reef building species found globally. A set weight of microplastics (biofilmed ground melamine, density 1.6 g/cm³) was released into canopies that represented recovering and healthy reefs to determine entrapment efficiency. Overhead and side cameras tracked microplastic distribution and trapping mechanisms. Furthermore, complimentary flow velocity profiles were acquired to understand the relationships between the canopy hydrodynamics and microplastic distribution. Our results provide an insight into microplastic transport dynamics and entrapment mechanisms within coral canopies. Results show that even sparse reefs may be vulnerable to notable microplastic trapping. The results provide insight that support the conjecture that canopies may act as a global sink for microplastic pollution. Further investigation is required in the exposure of these ecosystems to microplastics and impacts on the wider ecological system health, function, and potential subsequent transfer through food webs.