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# Source-specific patterns of anthropogenic debris and associated ecological impacts in the Red River, Vietnam

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## Abstract

Vietnamese rivers are among the top ten contributors of anthropogenic debris to the ocean. However, there is limited empirical research documenting debris and its effects in Northern Vietnam. The goal of our research was to conduct the first baseline assessment of anthropogenic debris in the Red River. We aimed to understand the sources, accumulation patterns, and ecological effects of anthropogenic debris in the Red River (Song Hong) estuary. To assess debris patterns, we conducted standing stock debris surveys at sites in the mouth, and upstream of the Red River. To assess the ecological effects of anthropogenic debris on mangrove ecosystems, we measured mangrove diameter, canopy cover, and number of crab burrows/m<sup>2</sup> in the same debris transects. Anthropogenic debris was found at all sites, and plastic was the most common material. We identified a non-significant trend, whereby ecological indices declined with increasing amounts of debris. Overall, our results demonstrate that anthropogenic debris is ubiquitous in the Red River estuary, composition varies among sites, and this debris may have adverse or neutral ecological effects on mangrove ecosystem health. Future work will assess community-level impacts of debris and other anthropogenic stressors (invasive species, chemical contaminants) at a larger spatial

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scale, and will assess the ecosystem-level impacts of debris removal. This research informs our fundamental understanding of how litter and other stressors impact biota in the Red River, while also contributing to our understanding of how management strategies for debris removal may be effective in large, Southeast Asian rivers.

**Keywords:** Southeast Asia, Vietnam, Macroplastic, Ecological Impacts, Multiple Stressors, River Plastics, River Ecology