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Citizen science sampling programs as a technique for monitoring microplastic pollution: results, lessons learned and recommendations for working with volunteers for monitoring plastic pollution in freshwater ecosystems

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Abstract A citizen science microplastic monitoring method was developed to engage the public and quantify microplastic contamination at various sites along an approximately 550 km length of the Ottawa River from Lake Temiskaming to Hawkesbury, Ontario, Canada. The volunteers filtered 100 L of river water through a 100-μm mesh at their desired location along the Ottawa River. All but one of the river samples ($n = 43$) contained microplastics, with the vast majority of microplastics identified as microfibers. Microplastic concentrations ranged from 0.02 to 0.41 microplastic pieces per litre. We noted numerous advantages in working with citizen scientists including actively engaging citizens in the research, ease of recruiting volunteers within the established Ottawa Riverkeeper network, and expanded spatial coverage at minimal additional costs. Despite these important advantages, there are some important considerations with citizen scientist sampling including the rare events where volunteers mislabelled sample sheets (e.g. labelling as control instead of river sample) and the relatively low volume of water (100 L) that the volunteers could easily sample using our methodology. Recommendations for future citizen science projects for freshwater microplastic research include utilising an established and engaged network, running both field and lab control samples (blanks) to obtain estimates of contamination with microplastic fibres, and increasing the amount of water filtered to obtain more reliable estimates of microplastic pollution in our freshwater ecosystems.

Keywords Citizen science · Microplastics · Ottawa River · Microfibers · Wastewater treatment · Anthropocene

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Introduction

Since 2014, global production of plastics has exceeded 300 million metric tonnes a year (Plastics 2016) with none of the commonly used plastics being biodegradable (Geyer et al. 2017). Consequently, tiny pieces of plastics known as microplastics are now ubiquitous in today's ecosystems. Microplastics are small plastic pieces less than 5 mm long which can be harmful to ocean and aquatic life (Masura et al. 2015). River environments have recently been identified as containing microplastics (Campbell et al. 2017; Leslie et al. 2017; Vermaire et al. 2017; Wang et al. 2017; Windsor et al. 2019). In fact, rivers are one of the major conduits (in addition to a sink and transformer) of microplastics to

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