Observing surface water currents and plastic pollution transport using GPS-tracked drifters

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To safeguard the near-pristine waters of Lake Huron's Georgian Bay from plastic pollution, Georgian Bay Forever began the "Tagging Trash Trips" project, which used GPS-tracked bottle-drifters to understand where and how water currents transport floating plastic pollution in Nottawasaga Bay, Georgian Bay. Nottawasaga Bay provides drinking water to local municipalities and is a travel destination for over 1.5 million visitors annually who inevitably produce plastic pollution. With time, waves and rocky shorelines break plastic pollution into smaller pieces that are less feasible to capture and become more harmful to organisms (Bucci and Rochman 2022) like the near-threatened Piping Plover that nests on Wasaga Beach. To date, there is little to no existing scientific empirical knowledge on Georgian Bay's water currents (Greenwood and Sherman 1983; Bennett 1988; Elbagoury et al. 2023), and how these water currents are involved in transporting plastic pollution (Belontz et al. 2022). Our objectives were to understand how water currents transport plastic pollution and to inform where limited resources should be prioritized for the capture and diversion of plastic pollution to minimize adverse consequences.

We enclosed GPS-trackers in plastic bottles that float half-submerged in water to emulate real floating plastic pollution. From the release of our drifters, we learned that most drifters entering Nottawasaga Bay were retained and had traveled tens of kilometers before reaching shore within several days. An apparent near-shore water current transported two drifters out of northern Nottawasaga Bay. This demonstrated that plastic pollution can be quickly transported into rocky areas of Georgian Bay, facilitating plastic fragmentation and reducing cleanup feasibility. Inertial motions of surface water currents caused by Earth's rotation (*Coriolis effect*) were observed as the clockwise spiraling motion of drifter paths when winds were weak. An animation of observed drifter tracks can be viewed online. Due to being half-submerged in the water, drifters directly interacted with winds and demonstrated wind-dependent transport, which contributed to drifters travelling twice as fast as would be expected from water currents alone. The use of drifters allowed us to identify spatial patterns of transport and accumulation to inform conservation efforts. The insight and methods of this research can be applied to other waterbodies to learn about surface water currents and plastic debris transport.

