BRIEFING NOTE

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BOOMS, GRIDS AND NETS: INTERCEPTING MACROPLASTIC DEBRIS IN RIVERS

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KEY FINDINGS

The simple floating boom design used by most projects are substantially less efficient at capturing litter than nets or other designs that trap litter deeper into the water column. It appears that device design is constrained more by the need to reduce the risk of loss through theft or vandalism than functionality. All devices struggle to operate effectively in high flow conditions, which means that even if they were installed throughout coastal urban waterways, they would have limited success in reducing spikes in litter reaching coastal waters and polluting urban beaches during very high rainfall events. Management should focus primarily on reducing litter loading into urban catchments through improved solid waste management, incentives to recycle and re-design of litter-prone items (especially packaging for convenience foods and drinks, and tobacco-related litter).

INTRODUCTION

South Africa is one of the worst polluters of the marine environment with plastics globally. Most of this plastic comes from land-based sources, resulting from chronic littering and poor waste management in many municipal areas. The quantification of litter flows in areas lacking waste delivery services remains a key goal in the country's national waste management strategy, which is vital in the identification of problematic waste types and areas where mitigation efforts should be focused. Until we can resolve the many challenges to effective solid waste management on land, one of the most effective interventions is to remove macroplastic items from storm water and rivers before it reaches the sea. Various devices have been designed to do this, ranging from floating booms and nets to grids and floating litter traps. However, we lack an overview of how extensive these efforts are, and more critically, we don't know how effective these efforts are in capturing plastic macrolitter. We need a systematic review of litter interception initiatives and their efficacy, including an assessment of the fate of materials collected. Ideally, most of the material caught in these devices should be recycled or composted, and if done properly, could help to support the sustainable servicing of the screening systems. By providing an inventory of current screening initiatives, this project also identifies areas where further screening measures could usefully be implemented.

METHODOLOGY

A survey of litter interception devices in the major urban source areas was conducted to gather information on the design and management. Litter was sampled from interception devices in three contrasting suburbs of Cape Town. Accumulation surveys of street litter were conducted in the same catchments which allowed more consistent estimates of litter inputs to better understand differential transport of litter material types. The efficacy of selected devices was estimated by inferring retention rates of different devices and by using marked litter items. A GIS model was built to estimate litter loads across the Cape Town metro area and identify key sites for additional installations of interception devices. This model was based on data from existing screening devices and variables such as catchment land-use, population density, waste servicing and rainfall to predict where installations would be most effective.

MAIN RESULTS

A total of 189 devices were identified along the coast of South Africa, with most concentrated in the major cities of Cape Town and Durban. However, this is a minimum estimate, because most municipalities failed to respond to inquiries about devices. Infrequent servicing and maintenance of devices coupled with high litter loads in many river catchments often leads to blockages and overflowing during high flow events.

Most devices consistently serviced and maintained are manged by private individuals or groups, often linked to NGOs or research institutions.

The highest daily litter loads intercepted were by the litter boom and nets at Marina Da Gama (2720 items and 9573 g·day-1), followed by the two litter booms at Liesbeek (1743 items and 6090 g·day-1), and the net and trap in Ocean View (1026 items and 4726 g·day-1). Plastics were the dominant material type by both number (77%) and mass (69%), followed by wood (18%) and glass (5%) in terms of mass. Flexible packaging such as food wrappers and bags dominated the macroplastic litter in urban waterways in terms of numbers of items (45%), but bottles, lids, and tubs (mostly PP and PET) made up more than half of single-use plastics by mass (53% by mass), despite comprising only 8% of single-use items by number. Although being the most common macroplastic item numerically (47% by number), foamed plastics constituted a much lower proportion of single-use plastics by mass (15% by mass).

The low-income site generated an order of magnitude more street litter daily (147.7 items and 396.6 g·100 m-1·day-1) than the high-income site (6.4 items and 27.8 g·100 m-1·day-1), with the mid-income site having intermediate values (42.8 items and 95.5 g·100 m-1·day-1). Plastics were the most common material type both numerically (49% of all litter) and by mass (47% of litter), followed by card/paper (16%) and glass (14%) in terms of mass. Cigarette butts comprised 28% of street litter items by number, but only accounted for 3% of the mass of litter.

Flexible packaging dominated single-use plastics in street litter by number (87%) and made-up half of the total mass (50% by mass), in contrast to rivers (45% by number; 33% by mass). Only 3% of single-use plastics in street litter by number were foamed plastics, despite being the leading contributor in rivers numerically (47% by number). This results in part from the ready fragmentation of EPS (especially sheets and trays used for food packaging) in freshwater systems.
The upstream litter boom at Marina Da Gama intercepted a larger proportion of buoyant items by number (68% by number) compared to the nets below (53% by number), but over five sampling events, three times as much litter was captured in the nets (25.7 kg) compared to the litter boom (8.5 kg), indicating that simple floating booms trap at most one quarter of the litter load. Just under half of all items intercepted by the litter boom were <5 cm in length (49%).

The model predicted that on average 26.0 (15.3–36.6) tonnes of street litter is produced in Cape Town daily, with 56% of this litter being loaded into three river networks; Salt/Black, Eerste and Diep Rivers. Key litter trap installation sites were identified in the Salt/Black River catchment area. The distribution of current litter traps in the city (mostly municipal traps installed in the 1980s and 1990s) was poorly correlated ($R^2 = 0.28$) to the catchments receiving the largest plastic litter weight daily.

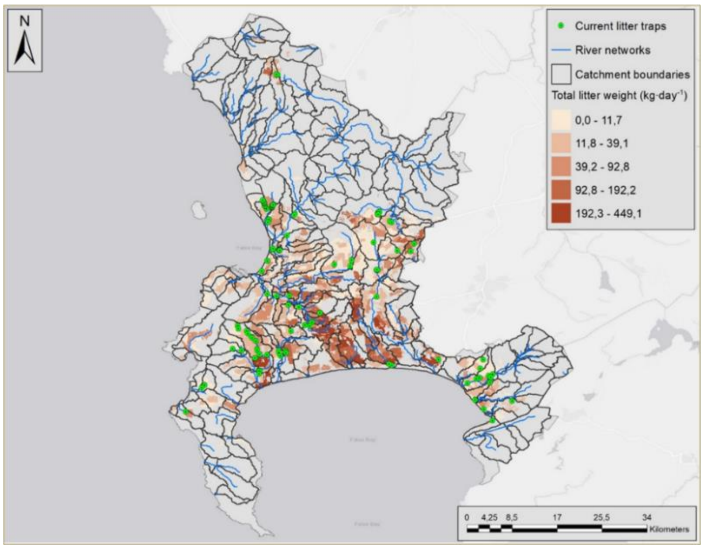

Figure 1. Current litter trap intervention locations (green dots) in relation to the top plastic litter producing catchments (yellow polygons) in Cape Town

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