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Baseline

Composition and abundance of marine debris stranded on the beaches of Sri Lanka: Results from the first island-wide survey☆

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ABSTRACT

This study provides the first assessment of marine debris washed ashore on 22 beaches along the coast of Sri Lanka. There was an average of 4.1 large (> 25 mm) and 158 small (5–25 mm) pieces of debris per square meter of beach. Classified by use, packaging material (55%) dominated the debris, followed by consumer products (25%) and fishing gear (20%). In terms of materials, plastic was the greatest contributor (93%) to marine debris. Beaches near a river mouth or city and those with a barrier had greater debris accumulations. The east coast had significantly greater small debris density, possibly due to strong northeastern monsoon currents. Large spatial heterogeneity was observed in the amount of debris. Long-term monitoring is imperative to better understand the temporal changes in, and the pathways and possible management of, marine debris.

We are living in a plastic era, and it is difficult to imagine modern life without plastics (Thompson et al., 2009a). Global production of plastics in 2015 was 322 million tons (PlasticsEurope, 2016), and this number is continuously increasing. Materials such as glass, metal, and paper have been replaced by plastics (Thompson et al., 2009b). Generation of persistent waste has increased proportionately to the dramatic growth in production. Despite several international policies and conventions related to marine debris (UNEP, 2009), such legislation is widely ignored, and millions of tons of waste are discarded in the ocean or washed out from shore (Derraik, 2002). An estimated 57% of plastic in Africa, 40% in Asia, and 32% in Latin America is not collected and becomes litter or is burned in the open (UNEP, 2014).

The buoyancy of marine debris facilitates its transport over great distances with prevailing winds, ocean currents, and tides, and it can accumulate along shorelines, even on the most remote islands (Lavers and Bond, 2017), as well as in the open ocean and deep sea (Barnes et al., 2009). Sri Lanka is an island with sandy beaches along much of its coastline, which is influenced by annual cycles of monsoonal weather patterns, and thus is prone to debris accumulation. Highly diverse nearshore ecosystems and sandy beaches are major attractions of the tourism industry, which accounts for 10% to the country's service-based economy (Central Bank of Sri Lanka, 2016). Therefore, marine debris could cause irreversible damages to both the ecology and economy of the country (White et al., 1997; Jang et al., 2014a). Nevertheless, Sri Lanka was ranked 5th among the top 20 countries discharging plastic debris into the world's oceans (Jambeck et al., 2015). Despite this, there has been no empirical study of the status of marine debris in Sri Lanka to date. Thus, marine debris stranded on beaches was surveyed along the coast of Sri Lanka to assess the present status of such waste. Here, the quantity, composition, and sources of marine debris were surveyed, and factors that may influence the differential accumulation of marine debris on different beaches were investigated.

Marine debris was surveyed on 22 beaches along the 1340-km coastline of Sri Lanka (Fig. 1). Sampling sites were very diverse and included long continuous beaches, pocket beaches, beaches near cities, those near river mouths, popular tourist destinations, and beaches isolated from direct human influence. The survey was conducted for a week beginning on 24 December 2016. In this study, any manufactured or processed solid waste material that enters the marine environment

☆ The English in this document has been checked by at least two professional editors, both native speakers of English. For a certificate, please see: http://www.textcheck.com/certificate/sbgH65.

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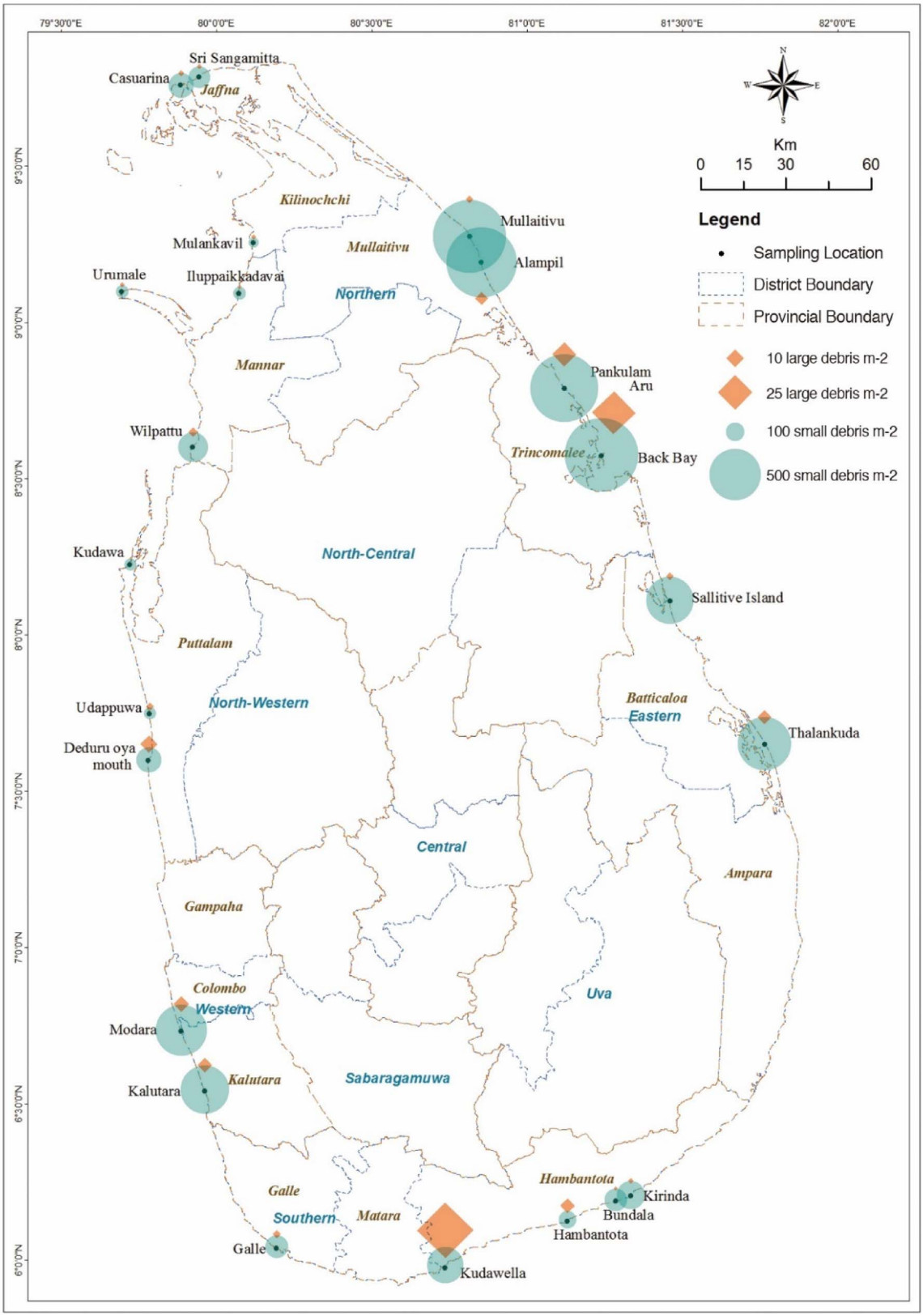

Fig. 1. Map of Sri Lanka showing 22 sampling sites with the relative density of large debris (red diamonds) and small debris (blue circles). (See Appendix 1 for more details). (For interpretation of the references to color in this figure legend, the reader is referred to the web version of this article.)

from any source was considered marine debris (Coe and Rogers, 1997).

On each beach, three large quadrats (10 × 10 m) were surveyed to determine the density and composition of large debris (> 25 mm). A team of four trained observers collected all debris encountered within the quadrat, identifying and categorizing it in situ while another person recorded the types of debris present along as well as their count and weight. To determine the sources of waste, large debris was categorized stepwise in three different ways. First, debris was classified as either