Mangrove Ecosystems as Natural Traps for Plastic Debris: A Case Study from Mandagasalaba Conservation Forest, Negombo, Sri Lanka

D.A.D.V. De Silva[1], R.M.S.K. Rathnayake[1], R.M.O. Dilthara[1], D.M.A.M.S.R. Andradi[1]
S.H.U. Chathurani[2], M.G.Y.L. Mahagamage[1]*
[1]*Centre for Environmental Studies & Sustainable Development, The Open University of Sri Lanka, Nawala, Nugegoda, Sri Lanka*
[2]*National Aquatic Resources Research and Development Agency, Crow Island, Colombo 15, Sri Lanka*
**mgyma@ou.ac.lk*

Mangrove ecosystems are highly productive coastal habitats that provide essential ecosystem services. However, their ecological integrity and functional capacity are increasingly threatened by plastic accumulation. Therefore, the present study aimed to evaluate the abundance and distribution of trapped macroplastics in relation to mangrove species composition, root system complexity, tree density, and site characteristics within the Mandagasalaba Conservation Forest, Negombo. Macroplastic abundance and composition were assessed using belt transects (2m × 10m) during the south-west monsoon season of 2025 for 10 sampling locations, yielding a cumulative sampling area of 200 m². At each site, transects were established perpendicular to the shoreline. All visible plastic debris entangled within mangrove trees and their root systems, ranging from 1cm to 115cm above ground level, was collected as trapped debris. The dominant mangrove species recorded in the study area were *Avicennia marina, Ceriops tagal, Rhizophora mucronata,* and *Rhizophora apiculata*. The identified macroplastic debris comprised Polyethylene Terephthalate (PET), Polypropylene (PP), Polystyrene (PS), High-Density Polyethylene (HDPE), Low-Density Polyethylene (LDPE), synthetic rubber, and others. Polystyrene was the most dominant plastic type, accounting for 21% of the total debris. The highest trapped plastic density was recorded at sampling location 3, which also had the highest tree density (2.25±0.41 trees/m²) and was dominated (98%) by mangrove species with prop roots and knee roots. In contrast, the lowest trapped plastic density was observed at sampling location 1, where only 40% of mangroves possessed prop roots and knee roots. Trapped debris heights varied among plastic types. LDPE reached the greatest trapping height (1.0–15.6 cm; mean: 4.5cm), whereas PET exhibited the highest mean trapping height (4.6 cm). The mean trapping heights of the remaining plastic types were 4.1cm for PS, 3.4cm for HDPE, 3.3cm for PP, 2.9cm for other plastics, and 2.3cm for synthetic rubber. Macroplastic accumulation in mangrove ecosystems is primarily influenced by root system complexity, tree density, geomorphology, and monsoon-driven debris inputs. In comparison to *Avicennia marina, Ceriops tagal* and both *Rhizophora* species possess more structurally complex root systems, including knee and prop roots, which may enhance their efficiency in trapping macroplastic debris, highlighting their role as effective natural barriers and pollution sinks. These findings underscore the importance of incorporating vegetation structure and seasonal hydrodynamics into mangrove conservation and plastic pollution management strategies.

Keywords: *Macroplastics, Mangrove-ecosystems, Trapped debris, Root system complexity*