

Identification and Spatial Distribution of Plastic
Marine Debris Polymers in the Hawaiian Islands:
Beach, Sea Surface, and Seafloor

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Abstract

This is the first study to assess the polymeric differences of plastic marine debris in multiple environmental compartments across the Main Hawaiian Islands (MHI). Plastic marine debris was collected from 11 coastal beaches, 3 sea surface net tows, and 3 seafloor SCUBA dives to spatially depict polymer distribution in the MHI region. Samples from Midway Atoll were also included in this study to represent the North Western Hawaiian Islands (NWHI). A weathering rank was created to investigate site differences in weathering intensity across all polymer types to potentially provide insight on aging and environmental exposure time. A total of 4,472 pieces were collected, in which a subset (n=3,821) was analyzed for polymer identification using Fourier-Transform infrared (FTIR) spectroscopy. The predominant polymers were high-density polyethylene (HDPE) (26.5%), polypropylene (PP) (26.3%), and nylon (22.8%) by mass, and low-density polyethylene (LDPE) (27.3%), PP (25.0%), and HDPE (16.8%) by number of pieces. Significant differences ($p < 0.05$) in polymer composition were found among four compartments: sea surface, windward beaches, leeward beaches, and seafloor. Sea surface and windward beaches were dominated by less-dense, more weathered, fragmented polymers, while more-dense, less weathered, whole item polymers dominated leeward beaches and the seafloor. Our results are some of the first to provide evidence of polymeric stratification in the marine environment. The results emphasize that biota in different environmental compartments are exposed to different forms of plastic pollution, and thus impacts from these plastics to marine organisms could differ depending on location.

Keywords:

Plastic Debris; Polymer Identification; FTIR Spectroscopy; Beach; Sea Surface;
Seafloor; Hawaii

Graphical Abstract

