Understanding plasticiser leaching from microplastics

Alexandra M. Gulizia, a,b Kishan Patel, a Bronson Philippa, a Cherie A. Motti, a,b,c George Vamvounis a,b

a College of Science and Engineering, James Cook University, Townsville, QLD, Australia
b AIMS@JCU, Division of Research and Innovation, James Cook University, Townsville, QLD, Australia
c Australian Institute of Marine Science (AIMS), Townsville, QLD, Australia

AMG: Alexandra.gulizia@my.jcu.edu.au,

Plastic pollution in the environment presents a unique threat to aquatic ecosystems and wildlife. Plasticisers such as phthalic acid esters (e.g., DEHP) and diphenols (e.g., BPA) are commonly incorporated at high concentrations into plastic polymers during their manufacturing to tailor the thermal and mechanical properties of the final products. Concerningly, many plasticisers elicit chronic toxicity responses in animals and humans, and through their association with plastic products and the long-term mismanagement of plastic waste, their concentration in environmental matrices is greatly increasing. Despite the ecotoxicity of plasticisers, the majority of research into their adverse effects has been conducted using consumer products under typical user conditions (e.g., the heat treatment of plastic food ware containers). Understanding plasticiser leaching behaviours from plastics under environmentally relevant conditions has been largely ignored in literature, particularly from a chemical perspective. In this study, the leaching of common phthalic acid ester and diphenol plasticisers from microplastics (<2 mm in diameter) were analysed under various environmental conditions and the factors impacting their leachable properties characterised. Mathematical models were generated to estimate plasticiser leaching profiles in varying aqueous solutions extended over time. Results obtained here will improve understanding of the fate and reactivity of environmental plastic pollution and reveal potential mechanisms that may impact the health of natural environments and wildlife.