



Project Background

- Plastic waste is one of the biggest challenges facing the environment.
- To date, significant research, media and policy attention has focussed on the visible legacy of plastic waste.
- However, many polymers tend to be relatively inert and so exhibit low toxicity.
- Thus, the toxicity of plastic waste is likely to be determined by the nature and concentration of plastic additives which may be released from the polymer matrix after the plastic enters the environment.
- Plastics contain numerous additives, e.g. plasticisers, which may leach from plastic waste into the environment. Some plasticisers such as phthalates are known endocrine disruptors.
- Yet knowledge of the occurrence and ecotoxicology of these chemicals in UK soils is severely lacking.

Distribution and profile

Reasoning: Macro- and microplastic litter is likely to be the primary source of plastic additives in the environment. The distribution of additives in a location will likely correspond to input and sources of plastics, which depends on land use, or proximity to industrial areas (e.g. landfill).

Question: What is the relationship between land use, plastic waste and quantity and chemical composition of additive contamination?

Plans:

1. Soils sampled from various land-use types (e.g. agricultural, urban, landfill). The concentration and composition of microplastics and macroplastics in these soils determined with FTIR spectroscopy.
2. Gas chromatography-mass spectrometry (GC-MS) used to determine the plastic additive profiles.



"Abiotic" Kinetics

Reasoning: In order to determine additives of particular concern, it is important to determine the rate at which they enter the environment after plastic deposition, and the relative contributions of different plastics to soil additive content. Given the diversity in the chemical structures of plastic additives, it is likely that degradation rates, and therefore persistence, will vary between and within classes.

Question: What are the leaching and degradation rates of plastic additives in the environment?

Plans:

1. The leaching rates of a chosen suite of additives from a set of common plastics into soil and solution will be determined.
2. The degradation rates of a chosen suite of additives into soils will be assessed using controlled environments to explore the effect of variables such as pH and temperature.

Overall aim: Investigate the distribution, profile and fate of plastic additives in the UK terrestrial environment.

Toxicokinetics

Reasoning: Earthworms play a primary role in soil processes and constitute a significant proportion of the diet of terrestrial vertebrate predators. Understanding the toxicokinetics of plastic additives in earthworms has implications for wider ecosystem functioning.

Question: What are the toxicokinetics of plastic additives in earthworms?

Plans:

Exposure of earthworms to plastic additives will be carried out in order to derive toxicokinetic parameters of common plastic additives (e.g. assimilation, elimination, bioconcentration factor).



Trophic Transfer and Biomagnification

Reasoning: The potential for bioaccumulation and trophic transfer of plastic additives in terrestrial food chains has not been well studied. Given the ubiquity of plastic waste in the environment, there is potential for (pseudo-)chronic exposure to plastic additives.

Question: Is there biomagnification and trophic transfer of plastic additives in the terrestrial environment?

Plans:

Determination of concentration and composition of plastic additives in samples collected from birds of prey, e.g. buzzards collected in the UK PBMS.

