EXPLORING THE FORENSIC POTENTIAL OF NOVEL SOIL PROFILING METHODS

INTRODUCTION
- The organic component of soil contains a wide variety of biochemical signatures
- The diversity in these signatures offers potential for developing novel investigative tools for forensic application
- We examined the discriminatory power of:
  1) plant wax profiles
  2) soil microbial DNA profiles

1. PLANT WAX PROFILES:
- include long-chain n-alkane (C_{21}-C_{35}) and fatty-alcohol (C_{20}-C_{34}) compounds
- are largely dependent on vegetation inputs
- could potentially provide investigative intelligence as to the likely vegetation coverage of an unknown soil sample

HYPOTHESIS: plant wax profiles depend more on land-use vegetation (LUV) than on location

METHODS
- Soil was collected from 3 urban LUV x 2 cities:
  - Shrub Border, Grassland, Woodland x Aberdeen, Milton Keynes
- Samples were ground and extracted for alkanes and alcohols as described in Dawson et. al. 2004, and analysed by GC and GC-MS respectively
- Data analysis: Relative abundance data were root transformed before forming a Bray-Curtis resemblance matrix. The resemblance matrix was used in multi-dimensional scaling (MDS) (Primer 6)

RESULTS
- Soil fatty-alcohol profiles (b) demonstrated greater potential in discriminating between LUV compared to n-alkane profiles (a)
- Soil fatty-alcohol profiles (b) from woodland soils were influenced by originating city, while other LUV classes were not
- Soil fatty alcohol profiles proved to be more dependent on LUV than location

IMPLICATIONS
- Plant wax profiles and soil microbial DNA profiles offer potential to develop novel profiling methods for forensic application
- Long-chain fatty alcohols may prove useful in providing investigative intelligence through eliminating/indicating likely land-use vegetation classes of an unknown sample
- Soil DNA profiles may prove powerful in evaluative comparison of evidence samples, allowing provenance-dependent comparison of soil evidence samples
- Further work required: to assess the sensitivity of novel profiling techniques to post-transfer factors, such as desiccation, persistence and contamination

2. SOIL MICROBIAL DNA PROFILES:
- include bacterial and fungal target micro-organisms
- may be influenced by post-transfer conditions, such as desiccation
- could potentially provide evaluative evidence in provenance-specific comparison of profiles

HYPOTHESES: Soil bacterial and fungal DNA profiles discriminate soils from different geographical locations, but fungal profiles are more robust with air-drying

METHODS
- Soil was collected from 4 different locations in Scotland: Hartwood, Glenbaugh, Sourhope, Mharcaidh
- Soil treatments: non-dried and air-dried
- DNA was extracted using MoBio PowerSoil extraction kit
- multiplex-TRFLP method was used to obtain bacterial (1087r/63fVIC) and fungal (ITS4r/ITS1fFAM) DNA profiles
- Data analysis: Relative abundance data were root transformed before forming a Bray-Curtis resemblance matrix. The resemblance matrix was used in MDS (Primer 6)

RESULTS
- Soil bacterial (a) and fungal (b) profiles demonstrated clear ability to discriminate soils originating from different locations
- Soil fungal profiles (b) were sensitive to air-drying treatment, while bacterial profiles (a) were robust to air-drying
- Soil DNA profiles proved to discriminate location
- Fungal profiles were more robust with air-drying

IMPLICATIONS
- Soil microbial DNA profiles may provide powerful detective tools in forensic application
- Soil microbial DNA profiling may prove valuable in the post-transfer phase, allowing for the differentiation of soils based on their microbial composition

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http://www.macaulay.ac.uk/soilfit/