SCOPING BIOLOGICAL INDICATORS OF SOIL QUALITY FOR NATIONAL SOIL MONITORING

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ISSUES

- Monitoring needs reliable indicators to assess status and changes in soil quality for different land uses and soil functions
- Soil monitoring at the national-scale will look for impacts of pressures and drivers, such as climate change, pollution or land management [1]
- Soil is fundamental to sustaining our health, economic livelihoods and environmental quality

STAGE 1: SELECTING BIOLOGICAL INDICATORS

- Biological indicators can provide useful information on 3 soil functions (Table 1)
- 183 potential biological indicators were identified from the scientific literature
- 13 indicators from 4 categories (Fig 1) were selected for relevance to soil functions and practicalities in large-scale monitoring
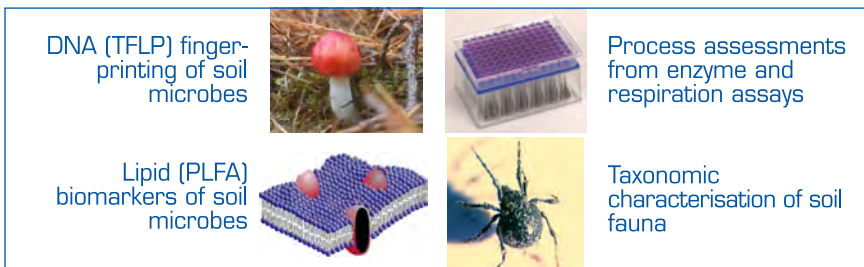- This candidate set is now being trialled at a range of spatial and temporal scales

DNA (TFLP) finger-printing of soil microbes

Process assessments from enzyme and respiration assays

Lipid (PLFA) biomarkers of soil microbes

Taxonomic characterisation of soil fauna

Fig 1. Characteristics of the candidate biological indicators of soil quality

Soil processes and properties	food & fibre production	environmental protection	supporting habitats & biodiversity
bio-aggregation of soil	X	X	X
carbon turnover	X	X	X
organic matter decomposition	X	X	X
pollutant degradation/ immobilisation		X	
Disease/pest transmission/ suppression	X	X	X
food source (aboveground)			X
germination zone for plants	X	X	X
Nitrogen turnover	X	X	X
nutrient supply from symbioses	X		X
Phosphorus turnover	X	X	X
soil redistribution	X	X	X
reservoir for soil biodiversity			X
S retention/release	X		X
tolerance/resistance to toxins	X	X	X

Table 1. Soil properties & processes supported by soil biology. X, where candidate indicators could provide information on individual soil functions

STAGE 2: KEY QUESTIONS BEING ADDRESSED FROM FIELD TRAILLING THE CANDIDATE BIOLOGICAL INDICATORS

(i)   Does temporal variability interfere with the sensitivity of the indicators to UK typical environmental pressures?
(ii) Can these biological indicators effectively discriminate between land uses and soil types in the UK?
(iii) Is there surrogacy between the indicators

Trial 1: Sensitivity of indicators

- Bi-monthly sampling over 12 months at long-term experimental sites reflecting 3 pressures: heavy metals in sludge, atmospheric N deposition and land restoration.
- **So far**: (i) Process indicators are the most sensitive indicators (e.g. Fig 2) but this sensitivity can be masked by temporal dynamics, (ii) Similar indicator responses suggest a degree of surrogacy.

Trial 2: Discriminatory power of indicators

- 100 soils are being analysed from seven land uses across Britain to investigate whether there are distinct indicator responses to land use (see Fig. 3).
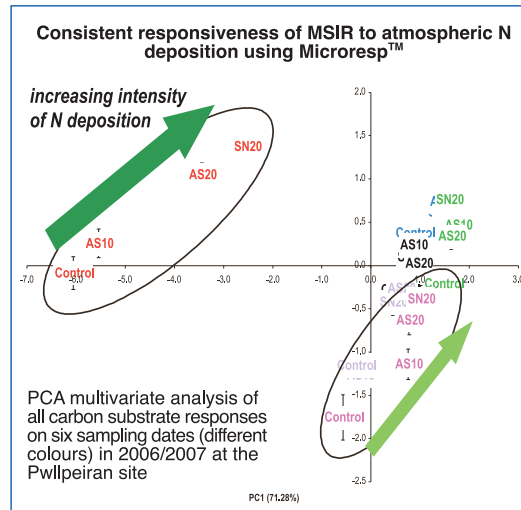
Consistent responsiveness of MSIR to atmospheric N deposition using Microresp™

increasing intensity of N deposition

PCA multivariate analysis of all carbon substrate responses on six sampling dates (different colours) in 2006/2007 at the Pwllpeiran site

Fig 2. Initial results from the sensitivity trial: Consistent response of MSIR to atmospheric N deposition using Microresp™

Oribatid mites species per soil sample in British land uses
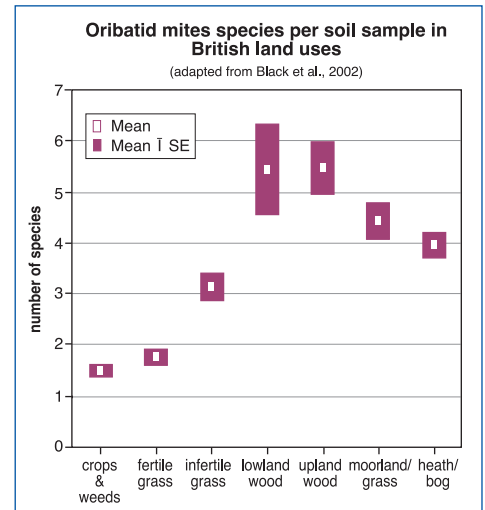(adapted from Black et al., 2002)

□ Mean
■ Mean Ī SE

Fig 3. Land use discrimination by soil fauna

OUTCOMES:

- A small number of biological indicators (13) could provide a wealth of information on three soil functions [food & fibre production, environmental protection and sustaining habitats & biodiversity].
- Process indicators are sensitive to pressures but temporal dynamics can mask responsiveness so timing of sampling may be crucial
- Surrogacy may be feasible but we need to assess how this affects coverage of soil functions against resourcing of monitoring
- We are also refining standard operating procedures to achieve consistently reproducible results