Testing indicators for soil biodiversity and ecological function in the European FP7 project EcoFINDERS

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Poster presented by Joke van Wensem, Soil Protection Technical Committee, NL

Aim of this work:

One of the major aims of 'EcoFINDERS' is the design of policy-relevant and cost-effective indicators for monitoring soil biodiversity and ecosystem function. To achieve this we:

- generated a list of potential indicators targeted to diversity or ecosystem function;
- determined the sensitivity of the indicators to land use change;
- evaluated the cost-effectiveness of the individual methods.

Material and methods:

Sampling sites:

To ensure European coverage and applicability we selected six agricultural sites; four arable sites from Atlantic, Continental, Mediterranean and Pannonian climatic zones, along with two Atlantic and Continental grassland sites. At each site there were three replicated plots of two contrasting treatments., named "Control" and "Treatment" . The comparisons included: tillage vs. reduced-tillage; cereal vs. fallow; conventional vs. organic arable management; and intensive vs. extensive grassland management.

Land Use	Treatments	Climatic Zone	Country	Site (abbreviation)
Arable	conventional/organic	Continental	Germany	Scheyern (LSC)
Arable	till/no-till	Atlantic	France	Lusignan (LLS)
Arable	till/no-till	Pannonian	Slovenia	Moskanjci LMO)
Arable	cereal/fallow	Mediterranean	Portugal	Castro Verde (LCV)
Grass	intensive /extensive	Continental	Germany	Hainich (LHA)
Grass	intensive /extensive	Atlantic	UK	Lancaster (LLN)

Potential indicators:

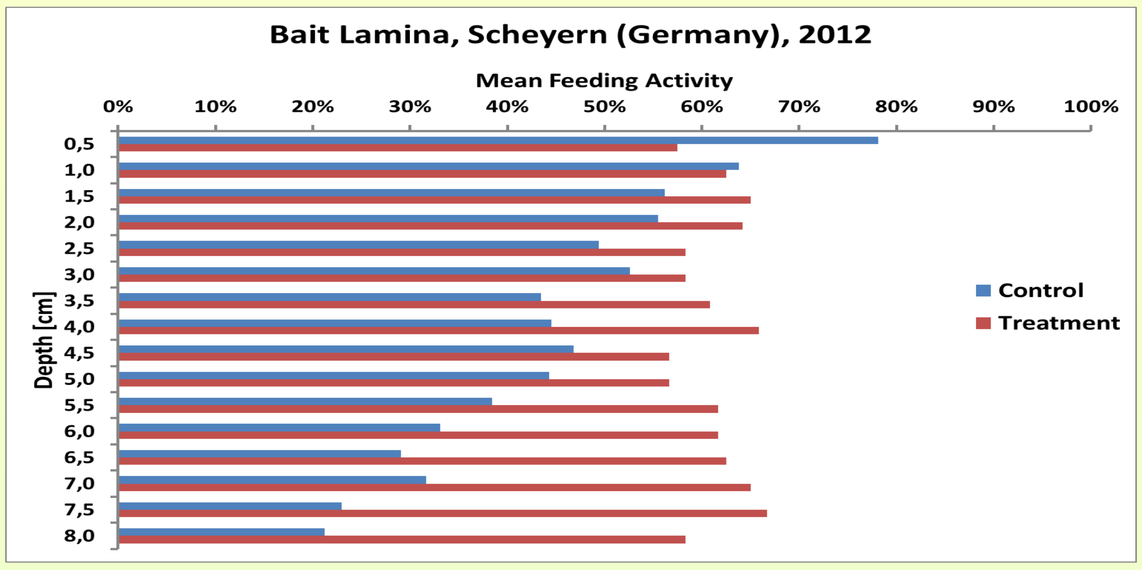
These were selected using a logical sieve (Ritz et al. 2009; Faber et al. 2013) according to: ease of measurement; cost; policy relevance; sensitivity and fit for purpose. In the following table, structural and functional indicators are divided by organism group. At each site the same number of samples were taken for all of these endpoints, using the same design. Sampling was performed twice (2012/2013). As far as possible, Standard Operation Procedures (SOPs) based on ISO guidelines were used.

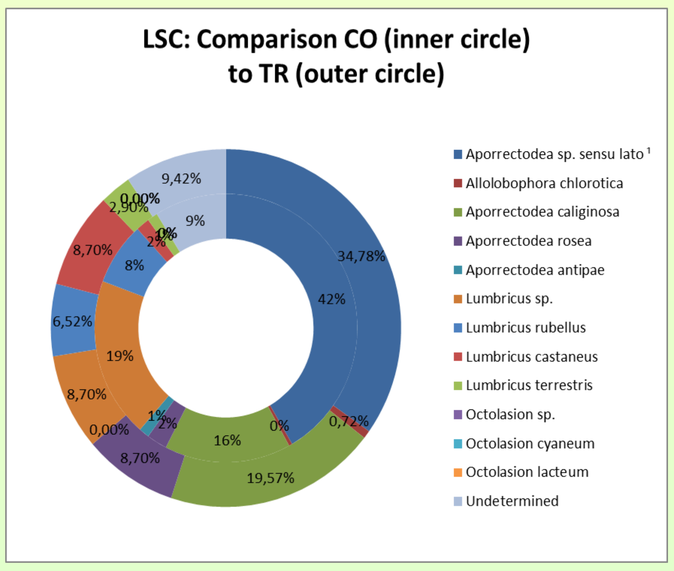
*Ritz. K. et. al. (2009): Ecol. Indicat. 9: 1212–1221; Faber, J. et al. (2013): IEAM 9: 276-284.

	Structure (biodiversity)	Function
Microbial	TRFLP Protists PLFA Ergosterol Nitrification Denitrification	Nitrification Denitrification Suppressiveness
Faunal	Earthworms Enchytraeids Micro-arthropods Nematodes	Earthworms Enchytraeids Micro-arthropods Nematodes
Process		Bait Lamina **Water infiltration** Resilience Nitrification Mineralisable C & N Micro-resp Enzymes

First results:

As expected, the absolute numbers measured by the selected indicators often differed considerably between the six sites (data not shown). The selected indicators proved sensitive to the land use changes at the sites as can be seen from the feeding rate results as measured by the bait-lamina method (see example below).





At the same arable site, neither earthworm community structure nor ecological group composition differed with treatment. However, abundance and biomass were higher in the control than the treatment plots, demonstrating that different indicators are necessary for an comprehensive site evaluation.

Some indicators such as water infiltration are logistically demanding but may have a high relevance to the objective. Such trade-offs need to be considered but we conclude that no single indicator will be appropriate for a monitoring scheme. A tiered approach will be able to combine efficient use of limited resources with enough power to address the specific question. Results from the six EcoFINDERS sites are being evaluated to identify the most suitable and cost-effective indicators.

Conclusions and outlook:

1. A combination of indicators is best able to describe the biological status of a specific soil and site. The idiosyncratic responses seen in the indicator sites demonstrate the utility of multiple indicators.
2. Standardization of methods is crucial for biological soil monitoring.
3. Follow project results at http://ecofinders.dmu.dk/workpackages/wp4/

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