

## Protists as bioindicators for soil quality

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Several unique features favour the use of heterotrophic protozoa as bioindicators for soil quality:

1. Protozoa are an essential component of soil ecosystems, because of their large standing crop and production. Changes in their dynamics and community structure very probably influence the rate and kind of soil formation and soil fertility.
2. Protozoa, with their rapid growth and delicate external membranes, can react more quickly to environmental changes than any other eukaryotic organism and can thus serve as an early warning system.
3. The eukaryotic genome of the protozoa is similar to that of the metazoa. Their reactions to environmental changes can thus be related to higher organisms more convincingly than those of prokaryotes.
4. Protozoa inhabit and are particularly abundant in those soil ecosystems that almost or entirely lack higher organisms due to extreme environmental conditions, e.g. alpine regions above the timberline, Arctic and Antarctic biotopes.
5. Protozoa are not readily dislodged in soil (Kuikman et al., 1990). Many (but not all!) are ubiquitous and are useful in comparing results from different regions. Differences in patterns of distribution are almost entirely restricted to passive vertical displacement; thus, the difficult problem, especially with the epigaeon, of horizontal migration does not affect the investigations.

There are, however, several factors that have apparently restricted the use of soil protozoa and even metazoa as bioindicators (Aescht and Foissner, 1992):

1. The immense number of species; more than 1000 may occur in a square metre of forest soil. Many specialists are needed for identification and each species has specific requirements that are often incompletely known.
2. Enumeration of soil organisms is difficult and time-consuming.
3. Animals need other organisms for food. Thus, the constellation of factors is more complex than in plants and bioindication often remains un-specific, i.e. different factors induce similar reactions.
4. Most soil organisms are inconspicuous and invisible to the naked eye, making them unattractive to many potential investigators.

In the lecture, I show examples from comparisons of ecofarmed and conventionally farmed fields and grasslands.

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