Mapping soil organism communities

A tool to integrate the assessment of the soil habitat function into planning processes

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Introduction

The purpose of the German Soil Protection Act is to protect or restore natural soil functions on a permanent sustainable basis. No provisions are given for the habitat function for soil organisms (PÖU 2003). The technical committee "Biological Assessment of Soils" of the German Soil Association (Bundesverband Boden e.V.) has developed a method for the assessment of soil quality with respect to its habitat function in the frame of planning processes (Beylich et. al 2005). A main component of the method is the mapping of soil organism communities as a prerequisite for the subsequent evaluation process.

Method Description

The method proposed here is meant to be part of the overall soil assessment procedure within a planning process on medium and large scales (1:50.000 - 1:5000). It should meet the following requirements:

- to map the distribution and spatial arrangement of soil organism communities in cartographic units,
- to display sites that have to be protected because of their special or rare soil organism communities,
- to detect areas where soil organism communities suffer already from disturbances,
- to forecast the effects of soil deteriorating measures on soil organism communities.

The method is based on the relations between abiotic soil properties (pH, soil moisture regime, soil texture), humus forms and land use on the one hand and the presence of specific soil organism community types on the other hand (fig. 1). Field investigations are only recommended at selected sites if e.g. the available data are insufficient, rare species / community types are expected or the given information suggests severe disturbances.

So far we distinguish 14 soil organism community types with a typical species composition of the soil fauna and associated typical humus forms:

"A" community types: Mull humus forms, anecic and/or endogeic earthworms present.

"B" community types: Moder or mor humus forms, anecic and endogeic earthworms missing.

The further differentiation is based mainly on the occurrence/absence of species of the soil mesofauna. The communities of agriculturally used sites are additionally differentiated by different levels of microbial biomass depending on the clay content. The soil fauna groups taken into account for the definition of community types are earthworms, enchytraeids, oribatid and gamasid mites, millipedes and isopods.

The mapping and evaluation of the expected condition is followed by the prognosis of the effects of the planned measures on the soil habitat and the integration of the results into the overall soil assessment (fig.2).

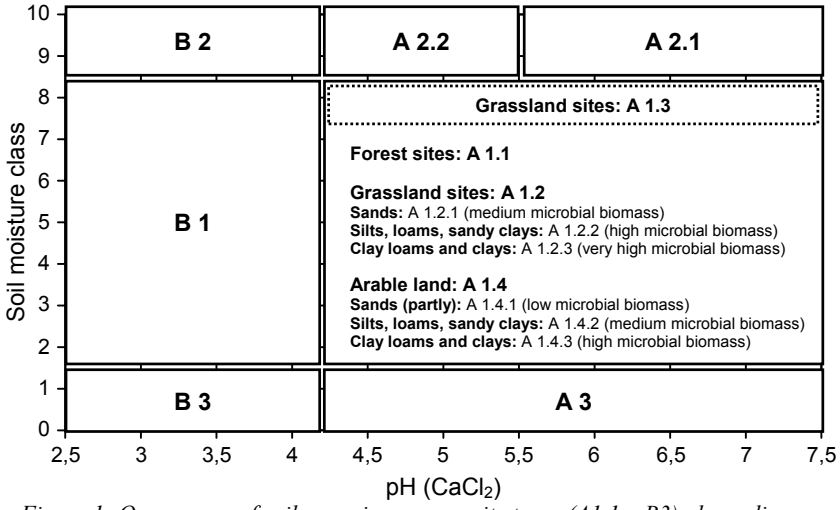

Figure 1: Occurrence of soil organism community types (A1.1 – B3), depending on soil moisture, pH and general land use (comp. Sommer et al. 2002).

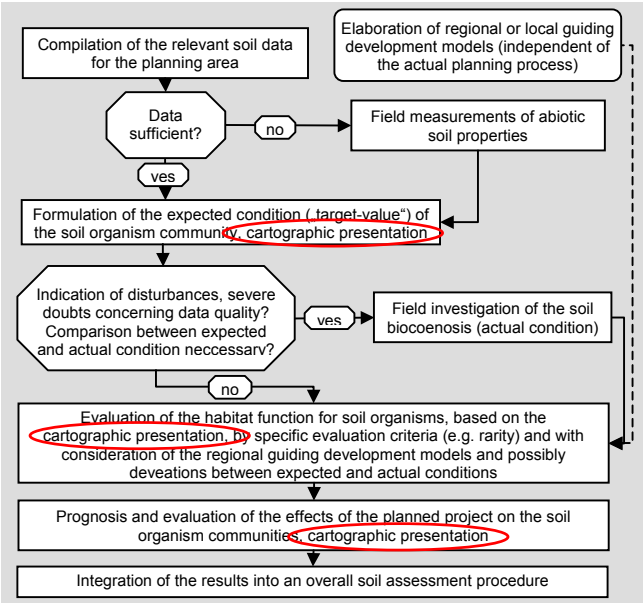

Figure 2: Assessment and evaluation of the habitat function of soils in planning procedures.

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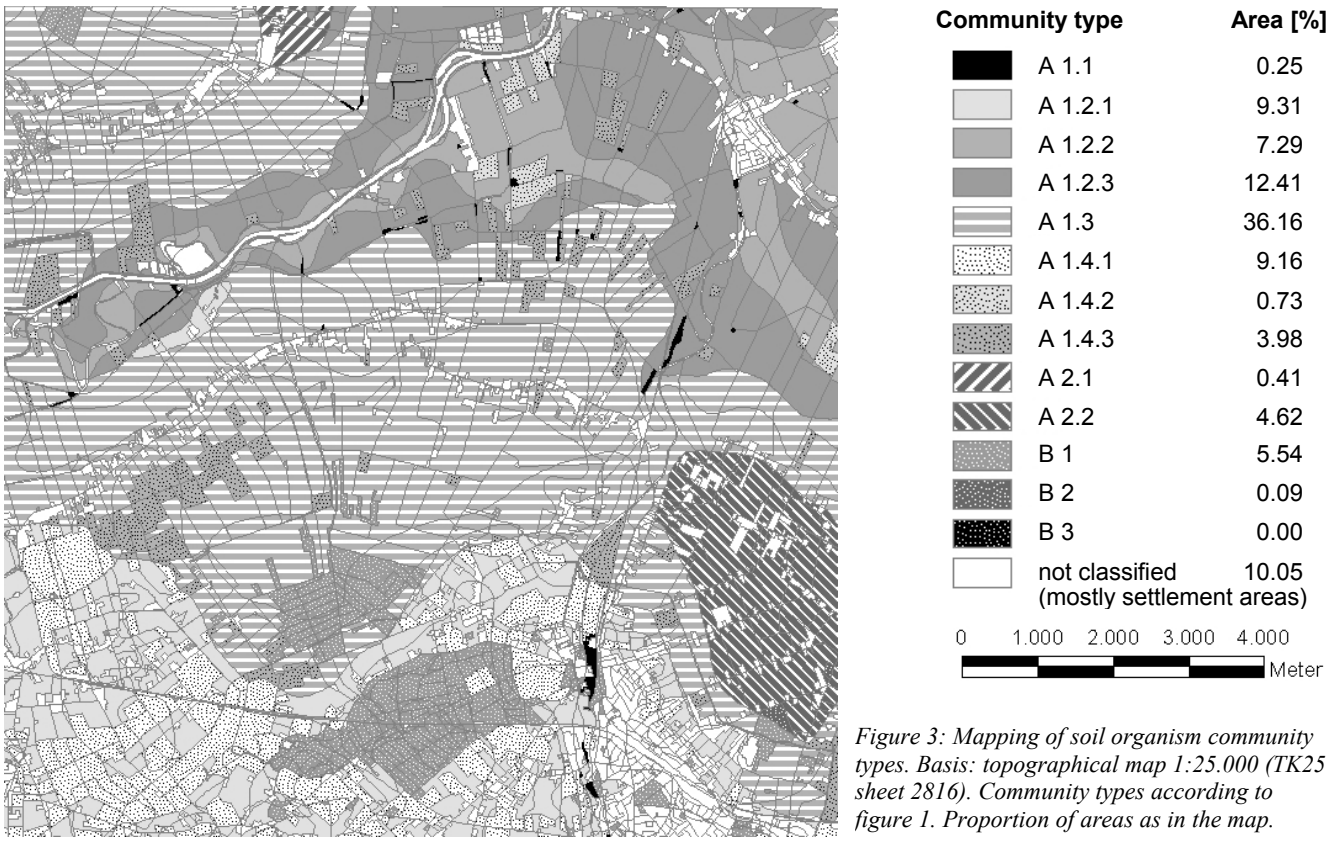

Figure 3: Mapping of soil organism community types. Basis: topographical map 1:25.000 (TK25 sheet 2816). Community types according to figure 1. Proportion of areas as in the map.

Method Application

If the necessary data concerning the abiotic soil properties are digitally available in a soil database, a map of the soil organism community types can be easily generated with a GIS (Geographic Information System). The map in figure 3 shows an area in the Northwest of Germany with predominantly agricultural land use. 13 of the possible 14 soil organism community types are present in the map section. The agricultural landuse causes fragmentation and isolation of community types at some spots. The aspect of rejoining the affected sites can be integrated into the process of choosing sites for compensatory measures.

One possible evaluation criterion within planning processes is the rarity of community types. The proportion of area of different community types can be calculated with a GIS. The results for the map section (fig. 3) are shown in the legend. The frequency of the community types is naturally different when considering different scales (e.g. natural landscape or state). Consequently the evaluation might produce different results for different scales. At any rate, the evaluation must be based on the development models (Entwicklungsziele, Leitbilder) drawn up for the region.

Conclusions

The integration of soil organism communities into soil evaluation has the potential of promoting restoration measures and land use recommendations based on soil biological aspects, especially in cases where a hazard for humans and crops is not yet given. This can be relevant for

- forestry planning,
- development planning in areas with moderate contamination,
- approval procedures for potentially polluting industrial plants.

Further fields of application:

- environmental impact assessment,
- flood control measures (e.g. polder construction, setting back of dykes),
- farmland consolidation,
- planning of compensatory measures necessary due to environmental impacts by the planned project.

Starting points for further development:

- completion of soil data bases as not all data on abiotic soil properties are available in the required map scales,
- purposeful and comprehensive data analysis concerning ecological behaviour of soil fauna species to corroborate community type definitions,
- field validation.

References

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