

The Biological Soil Classification Scheme – a management tool for the assessment of the conservation value of secondary forests in the Brazilian Atlantic Rainforest

Hubert Höfer

The Brazilian Atlantic rainforest is a „hot spot“ of biodiversity and it is internationally recognized that its overwhelming diversity or species richness must be preserved. The Non-Governmental Organization SPVS (Portuguese acronym for the Society for Wildlife Research and Environmental Education) is working on the base of private partnerships and sponsorship on their mission “Conservation of biodiversity” in the southern part of the Atlantic Coastal Rainforest in the state of Paraná. The same objective led the Brazilian and German Ministries of Science to initiate in 2001 a program called „Science and Technology for the Mata Atlântica“. In this program we study the soil fauna and the soil conditions of pastures, secondary forests of different age and on different soil types, together with our Brazilian partners from the University of Paraná, in areas owned and managed by the local organization SPVS.

Under the pressure of ongoing degradation of forest sites in the Mata Atlântica the development of management tools for conservation must have a high priority. To decide which areas must be preserved, which should be restored, and which can and should be used in a sustainable way, we need to be able to recognize and evaluate the quality or conditions of a given site or habitat. The soil condition and especially its function as a habitat for soil organisms are of special importance for the maintenance of the species-rich Atlantic forests.

Soil is the upper layer of the earth crust composed of mineral parts, organic substance, water, air, and living matter. The term “living matter” can be specified as “organisms” or even better “plants, micro-organisms, animals, and their interactions (i.e. functions)”, as done, for example, in the German Plant Protection Law (PflSchG 1998). This law cites the following functions of the soil: habitat function, part of water and nutrient cycles, medium for decomposition (including medium for filtering and thus groundwater protection), and archive of natural and cultural history. From a purely anthropocentric view soil is a medium that holds raw materials, provides land for settlements and for agriculture and forestry and for other public uses. It is today internationally recognized that soils and soil biota have to be protected! Soil biota, microbial organisms, and small to tiny animals are

crucial to create and maintain the soil as a living system, guaranteeing the recycling of nutrients from the plant residues, thus forming a real „life support system“. The German soil protection act calls for the development of a broad, holistic approach with biological objectives. The same is said in the first EU paper on soil protection, entitled “Towards a Thematic Strategy for Soil Protection” (April 2002). Explicitly, the following problems are listed: erosion, decline in organic matter, contamination, sealing, compaction, decline in soil biodiversity, increased salinity, floods, and land slides.

Soil fauna is of special interest in the tropical forest ecosystems of the Mata Atlântica of Brazil due to the following reasons:

Under the aspect of diversity: Invertebrate animals like nematodes, earthworms, snails, and particularly arthropods including spiders and insects hold more than 70% of the world's diversity. The majority of animals in terrestrial habitats are invertebrate members of the decomposer community, and thus soil fauna provides a very large part of the diversity in terrestrial ecosystems. Soil organism diversity is important because it ensures a multiplicity of functions under a variety of environmental conditions and guarantees a source of new species performing functions under changing conditions (Wolters 2001).

Under the aspect of their function: about 80% of the carbon cycles through the decomposer food chain. Soil fauna controls soil organic matter stability (SOM) which is a key factor for many soil functions and for soil quality (Wolters 2000, Tian and Badejo 2001) and this is especially true for tropical soils.

Under the aspect of conservation: land use and global change strongly affect SOM and soil communities (Lavelle et al. 1997). As human interference and the use of external inputs decrease, soil biodiversity and its soil biological processes maintaining soil fertility and productivity increases, and the opportunities for soil biological management become more feasible (Swift 1997). For example, management interventions might reduce the populations of soil-borne pathogens, pests, and parasites and enhance the populations and activities of beneficial organisms such as symbiotic rhizobacteria and mycorrhizae, organic matter decomposers, mineralizers, and ecosystem engineers. The outcome will be increased production of food and other agricultural goods, improved resilience of agricultural eco-



systems, and increased capacity to sustain production in the short- and long-term.

Therefore there is an urgent need for biological methods to assess the conditions of the „living system soil“ and to evaluate and monitor soil quality and soil functions. By no means can the habitat function of soil be measured by pedological properties and physical/chemical variables only. The strength of the fauna as an indicator of habitat quality is the integration of the endless co- and counteracting abiotic and biotic variables.

Our approach for the regional situation of the Atlantic rainforest in the state of Paraná is to develop a management tool for a soil classification scheme based on the soil organisms and thus on the habitat function of the soil (Ruf et al. 2003). The final aim is to provide a standardized procedure for the assessment of the conservation value of given habitats.

With this tool we will be able to evaluate the habitat function of soils in habitats influenced by man, by first defining „reference faunal communities“ for certain habitat types or ecotypes and then measure the deviation of the site of interest from this reference condition.

How will we proceed in the Atlantic rainforests of Paraná?

We are in the first phase in which we do a so-called functional study in six sites of two habitat types (submontane forest and Restinga). This is to overcome the problem that for tropical soil fauna we practically do not have any autecological and biogeographical background knowledge. Here we sample and describe several pedological and chemical parameters

like grain size distribution and pH, measure several nutrient pools and their dynamics, and experimentally study the quantitative contribution of several soil taxa to decomposition. In parallel we already started to study selected taxa like earthworms, ants, and spiders in several „near natural“ forests of the same two different habitat types, and under different soil conditions (well drained cambisols and water influenced gleysols). Correlations between soil fauna occurrence and abiotic parameters will be revealed, which are in fact the basis for the first step in the development of a Biological Soil Classification Scheme: the formulation of habitat types for which „reference faunas“ will be defined. The statistical procedure is done on the base of a cluster or correspondence analysis. Next step is to sample disturbed sites and describe and evaluate deviations from the reference conditions. In the second phase of the project (2005-2007), we will sample many regional habitat types to enlarge the database, check for biogeographical bias, and judge the feasibility of a regionally based Biological Soil Classification System (BBSK), which in our opinion is a prerequisite for the protection of habitats and biocenoses for the maintenance of the ecosystems functions, not only in the Atlantic Coastal Rainforests of Brazil.

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