

Foundations, measurements and trends in pedodiversity

Juan José Ibañez^a and Marco Pfeiffer^b, ^aNational Museum of Natural History (MNCN), Spanish National Research Council (CSIC), Madrid, Spain; ^bDepartamento de Ingeniería y Suelos, Facultad de Ciencias Agronómicas, Universidad de Chile, La Pintana, Chile

© 2023 Elsevier Ltd. All rights reserved.

Introduction	726
The concept of diversity	727
The scientific concept of pedodiversity	727
Pedodiversity and its measurements	727
State of the art on the relations between pedodiversity and biodiversity and their preservation	728
The conundrum problem to reach full diversity inventories	728
Main mathematical tools in diversity analysis	728
Richness–area relationships	730
Abundance distribution models	731
β diversity index	732
Diversity and the nested subset theory and taxa-range size distributions	733
Nested subsets theory	733
Taxa-range size distributions	734
Diversity, fractals and multifractals	734
Diversity, fractals and multifractal: What are the relationships?	734
Diversity, fractals and multifractals in soil sciences	735
Diversity analysis and the Willis curve	735
The broad universe of the Willis curve distributions	735
Willis curve and long tailed distributions. The example of soil mapping	736
Scaling hierarchies and the ht-index	736
The logarithmic thinking: Cognition soil maps and soil taxonomies	737
Summary	737
References	738

Abstract

Pedodiversity is a neologism of soil diversity concerning to the analysis of the number of soil classes or pedotaxa using mathematical procedures. However, the same tools are shown to be useful for other purposes such as the analysis of the structure of pedological hierarchical taxonomic systems and the standards for soil surveys and maps. Pedodiversity tools are described including their relations with other mathematical approaches, including: nested subset analysis, species–range size relationships, fractals and multifractals and complex systems. One of the most relevant findings obtained in pedodiversity analysis is that the patterns/regularities are the same for pedological and ecological entities, among others.

Key points

- Why should pedodiversity be analyzed?
- What are the mathematical tools applied to diversity studies?
- What patterns and regularities are detected in studies on pedodiversity?
- Comparison between the patterns of biodiversity, pedodiversity and geodiversity.
- Applications of geodiversity studies in other fields of knowledge.
- What is the role of the human mind in the patterns and regularities detected?

Introduction

Traditionally, soil has been defined from the soil forming factors (parent material, climate, biota, physiography, time and human intervention). The evolution of life on Earth has created the soil and it is impossible to imagine our planet without this natural resource, since it is the product of the interaction between the geosphere, biosphere, atmosphere, hydrosphere and cryosphere. Soil has been the driving force of plant diversity and the origin of new species. Likewise, the soil is the habitat for soil organisms and is at the interface of above- and below-ground biodiversities. Therefore, knowledge of the diversity and variety of the world's soils (pedodiversity) is vital for maintaining the biosphere, guaranteeing food security, and protecting the climate system itself.