# Seasonal dynamics of agricultural land use impacts on earthworm communities: Insights into diversity, abundance, and functional composition

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Abstract

Earthworms play a key role as soil bioengineers, but livestock farming and croplands can impact on the composition, structure, and functioning of earthworm communities. This study aimed to quantify the effects of replacing natural grasslands with crop rotations on the seasonal dynamics of key attributes of earthworm communities and explore soil physicochemical properties as mechanisms behind these effects. We conducted paired samplings on seven sites across Uruguay, comparing earthworm communities in soils under grazed natural grasslands and adjacent croplands, considering earthworm species composition, richness, diversity, and evenness, biomass, density, and mean body weight, over five consecutive seasons. Results revealed a clear negative impact of croplands on earthworm communities, showing substantial reductions in all considered attributes. Observed changes were attributed to environmental filters limiting the occurrence of larger exotic earthworm species in croplands, and variations in soil physicochemical properties were identified as potentially mediating some of these effects, including soil water regime (particularly affecting juvenile individuals) and soil organic matter content. These impacts resulted in a shift to dominance of r strategists (smaller, surface-feeding species such as Microscolex spp. in croplands compared to larger deeper-burrowing species in grasslands) and reduced functional composition of earthworm communities. Furthermore, seasonal dynamics revealed that differences between land uses were more pronounced during wetter periods, underscoring the relevance of seasonal variations when evaluating land use impacts on earthworm communities. Earthworms mean body weight resulted a useful attribute to be included in earthworm's assessments, allowing to identify impacts in community functional composition and suggesting size dependent mechanisms. Additional research is required to comprehensively understand the mechanisms behind these patterns and to develop more sustainable agricultural practices by considering soil fauna.

Keywords
Land-use impacts; Oligochaeta; Soil macrofauna; Agroecosystems; Functional traits; Temporal dynamics