

Earthworm bioturbation in relation to soil conditions

Soil organisms play an important role in different soil processes. Earthworms, as ecosystem engineers, have a key role in the biological reworking of soils. This process is known as bioturbation.

Earthworm bioturbation, has several impacts in soil structure, water regulation and nutrient cycling. Different environmental conditions like pH, soil compaction, moisture content temperature, soil mechanical resistance, soil organic matter and soil texture, affect earthworms growth, development, reproduction and distribution. Due to human activities (e.g. agriculture) some of these conditions can be easily modified. The literature review reveals gaps in the understanding of how the changing conditions of soils affect the temporal dynamics of earthworms activity and how earthworms change their locomotion mechanisms as a function of mechanical restrains. In addition, the conditions in which earthworms have optimal bioturbation rates, in terms of burrowing production, is not clear. Hence, the aim of this PhD is to reduce these gaps by quantifying changes in earthworm bioturbation rates when soil conditions are modified, focusing on soil compaction and SOM.

The initial experiments are designed to identify the earthworm mode of locomotion when the organisms are exposed to different levels of soil compaction in a 2D terraria. Subsequently, the experiments will combine the initial assessed compaction levels with different SOM concentrations, to create multiple scenarios. With these experiments, we would like to find at which soil conditions the optimal bioturbation rates (burrowing activity) can be seen. Another part of the project consists of quantifying the energy costs of the earthworms using isothermal calorimetry. This will be combined with X-ray imaging, to establish the earthworm mode of locomotion. Finally, to assess how earthworms respond to non-uniform soil and variable climatic conditions, laboratory experiments will be repeated in natural field conditions.

The PhD project will try to connect the knowledge of soil ecology and soil science, to assess more profoundly how soil compaction and SOM interact with earthworm behaviour. We expect to provide quantitative information on earthworm bioturbation, by creating a scientific basis that provides a better insight into earthworms behaviour. This information can be meaningful to be used in different soil management strategies, such as “soil ecological intensification” approach, or used in modelling of soil structure and soil organic carbon turnover.