Possibility of bachelor/master theses on the effect of earthworm colonization on plants and carbon stocks in boreal forests – Umeå University

Boreal forests are an important ecosystem at the planet level, as they represent 30% of the total forest area and provide several ecosystem services (Gauthier et al., 2015). They are a substantial resource for the wood production sector in many countries including Sweden, and store organic carbon in their soil, what helps regulate climate change (Bradshaw and Warkentin, 2015). The stability and specificity of these ecosystems is attributed to the harsh conditions they must endure, with very limited growing seasons. This could also be due the absence of burrowing earthworms and other large soil fauna which are known to profoundly impact soil properties and indirectly, plant composition (Blume-Werry et al., 2023). However, climate change and recent human activities facilitate the colonization of boreal forests by burrowing earthworms (Bohlen et al., 2004). The exact impact of earthworm invasion on boreal forests is not well known, but based on the effect they had on forests in North America post invasion, they are susceptible to increase soil organic carbon losses through the disappearance of the forest floor (increased decomposition of the organic matter) and to modify completely the plant composition in the short term (probably due to changes in nutrient availability), leading to strong changes in ecosystem functioning in the long term (Frelich et al., 2012).

The present project aims to investigate the effect of earthworm invasion of previously earthworm-deprived Swedish boreal forests on plants composition and growth and carbon stocks, using a mesocosm experiment with earthworm addition in previously earthworm-free turfs from the boreal forest.

Background: 48 intact turfs from the boreal forests (60*40*30 cm depth non-disturbed soil cores including the original organic soil layer and vegetation) have been collected in the summer 2023 in northern Sweden and brough to a common garden, where they were kept in mesocosms during 2 years. Burrowing earthworms were added to some of the mesocosms while others were kept earthworm-free as controls. Plant community composition and CO2 fluxes were monitored regularly during this period. After 2 years, the mesocosms were harvested for further analyses (September 2025).

The present thesis will involve some laboratory work (post-harvest measurements). These will mainly consist in measuring “traits” of the collected plants (biomass, length, content in carbon and nitrogen), and especially root traits using a root scanner, as well as characterizing the different soil horizons (carbon content, state of decomposition of the soil organic matter). The obtained dataset and the other available data will then be used to write a thesis that could deal with the following topics:

- **To investigate the effect of earthworm addition on changes in the plant community and plant growth.** This can be done using the data on plant growth and species composition collected before/during the thesis. There is also data available for CO2 fluxes and nitrogen availability.

- **To investigate the effect of earthworms on changes in carbon stocks,** both in the soil and in the vegetation. This can be done using the obtained data on soil and vegetation carbon content, vegetation biomass and soil density, and potentially soil organic carbon stage of decomposition depending on the interest of the student.

We are looking for one or two students (one for each topic), according to the type of thesis and interest.

Update: We have already one master student working on the vegetation part, but we are still looking for a student on the carbon part, potentially helping with the plant measurements if needed.

Place of work: Department of Ecology, Environment and Geoscience, Umeå University, Umeå

Start: ideally around January 2026, can be discussed (especially for bachelor students)

Supervisors: Gesche Blume-Werry (gesche.blume-werry@umu.se), Camille D'Hervilly (camille.d-hervilly@umu.se): please email us **both**.

Litterature cited

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