UMEÅ UNIVERSITY

The Sound of S(o)ilence

a study into the sounds of the world beneath our feet

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Academic dissertation

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Abstract

Soil is one of the most diverse systems on Earth, containing up to ~59% of all terrestrial living species and an important natural resource. Unfortunately, soil and its biotic processes are often overlooked in large monitoring schemes because monitoring is very labour-intensive and expensive. Moreover, traditional soil monitoring methods can be highly invasive and destructive to the ecosystem. In recent years, a potential new method has been developed: soil ecoacoustics. Soil ecoacoustics is a non-invasive method that uses passive acoustic monitoring to record sounds that can provide information about the fauna living in the soil.

In this thesis, I developed a prototype of a passive acoustic monitoring system designed to monitor soil macrofauna. I performed multiple experiments in the laboratory and in the field to explore the advantages and limitations of this method. The system was tested on two species groups: red wood ants (*Formica rufa*) and earthworms (*Oligochaeta*). I also evaluated the potential impact on system performance as a result of soil texture (mineral soil and organic soil). The sound recordings were analysed using multiple different acoustic indices and variables.

The results showed that it was possible to detect both ants and earthworms using my passive acoustic monitoring system. Sounds from the ants can be used to understand their diurnal shifts in activity, while also detecting increased activity inside the mound caused by a common pesticide. Earthworm activity was detected in both mineral and organic soil; however, at a varying degree depending on the soil and the applied acoustic variable. These results imply that the system is likely not universal, but may have to be fine-tuned for each soil type to get the best results. I also identified challenges hampering continuous monitoring related to the power supply and the large amount of data generated. So, while this outlined method is an extremely promising tool to monitor soil fauna activity in different soils, the system needs to be developed further to combat technological challenges.

Keywords: Passive acoustic monitoring, soil fauna, ecoacoustics, behaviour, Formica rufa, Oligochaeta

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