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SOUNDS OF THE SUNSET COAST

A post-phenomenological exploration of farmers perceptions of soil ecoacoustics

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ABSTRACT

Ecoacoustic research methods have expanded to in-situ recording of the sounds of soil. Studies to date have found soil acoustic complexity and diversity positively correlate with soil invertebrate abundance and richness, building evidence that soil ecoacoustics has the potential to help measure and monitor soil biodiversity. Here farmers were exposed to soil sounds using a specialised contact microphone. In-field observations and interview transcripts were analysed taking a post-phenomenological approach to answer the question "What are farmers lived experience of the soil? Does this technological, sensory-extension change that experience and their perception of the soil?" At the time of submitting this abstract, preliminary findings have revealed the farm as an ecosemiotic landscape, with semiosis closely linked to affordance. Farmers contextualised the experience of listening to the soil within their existing soil knowledge, expressing interest in ecoacoustics if it were able to be linked to affordance through quantitative data. This research seeks to add a qualitative perspective to the growing interest in soil ecoacoustics. Specifically using post-phenomenology, ecosemiotics and ecological psychology analysis in ecoacoustic and soundscape research, exploring how people make meaning from the hidden sounds of the landscape through their lived experience.

1 INTRODUCTION

Ecoacoustic and soundscape ecology research seeks to demonstrate how acoustic signals can be captured and analysed to characterize the soundscape of an ecosystem as an indicator of ecological conditions (Qi, 2008). By investigating the ecological relevance of acoustic dynamics and patterns, ecoacoustics thus considers sound to be a component in, and an indicator of, wider ecological processes (Farina et al., 2021). Recently, ecoacoustic research methods have expanded to in-situ recording of the sounds of soil. Maeder et al. (2022) found acoustic diversity in soil recordings was significantly associated with soil communities, suggesting that acoustic complexity of soil soundscapes could help predict the temporal and spatial dynamics, diversity and community composition of soil organisms.

Importantly, with soil health globally on a decline due largely to above-ground land use, soil ecoacousitc research has been shown to support restoration ecology. In tropical forests, results from research by Metcalf et al. (2024) suggest disturbance of land cover can alter the soil soundscape. Robinson et al. (2023) found recordings in restored forest plots had significantly greater high-frequency to low-frequency ratios compared to deforested plots, suggesting higher biophony to anthrophony ratios as forest regenerated. Robinson et al. (2024) found acoustic complexity and diversity were significantly higher in revegetated and remnant Australian grassy woodland ecosystems, compared to plots where timber had been cleared. In another use case tracking invasive earthworms in Arctic tundra, Keen et al. (2022) found soils containing earthworms are significantly louder than soils without earthworms, supporting the use of acoustic techniques to track invasive earthworms and monitor their re-engineering of soils.

In New Zealand agricultural soils earthworms are used as a general indicator of soil health and worm counts are a component of Visual Soil Assessments (Shepherd, 2000). Agricultural management practises have been shown to have a complex effect on the soil. Schon et al. (2008) found earthworm abundance to be greater in paddocks with high-intensity of stocking and fertiliser use, with low-intensity paddocks found to have lower earthworm numbers but higher density and diversity of soil mesofauna. A further study on sheep-grazed hill country concluded that management practises such as stocking rates and fertiliser regimes can influence soil invertebrates by

altering food resources and the physical soil environment (Schon et al., 2011). These findings, taken into consideration with findings of soil ecoacoustic research, support using soil soundscape analysis as a noninvasive method for soil biodiversity monitoring in agricultural soils. Further research is necessary to begin linking acoustic recordings to wider soil ecosystem health measures or pasture productivity.

Acoustic recordings are commonly analysed using Acoustic Indices, putting two layers of technological computation between a farmer and gaining an understanding of what acoustic recordings from the soil may represent. According to Farina et al. (2021) ecoacoustics, through investigating the role of environmental sound in ecological processes and dynamics, begins to treat the wider acoustic environment as a semiotic medium. This research follows this thinking by postulating the farm as an ecosemiotic landscape; the ecosemiotic approach examines sign processes in ecosystems, focusing on how organisms perceive and modify their environments. With this framing the question becomes whether a farmer hearing the soil may, after experiencing the sound enough, include this in their repertoire of signs and signals observed in the farm ecosystem.

The ecosemiotic framing also offers up the idea that the soil sounds are a co-evolved semiosis, reflecting the complex interaction of farm management practices with local soil ecological and geological processes. As Bradfer-Lawrence et al. (2019) argue, geophony can form an integral part of a soundscape and can be just as unique to an environment as the biophony. Hence while acoustic technology is increasing in effectiveness of detection and differentiation of sounds from biological, geological and anthropogenic sources, the cumulative soundscape can still be a tool in gauging the overall state of the soil system.

2 METHODS

Semi-structured interviews were undertaken on-farm with eleven farmers in a remote, moderate hill country area of New Zealand. Farms were all within geographical proximity, with recruitment of participants through a local catchment group. Catchment groups are collectives of farmers within the same hydrological catchment who share knowledge and cooperate to take collective action to improve stream and wider environmental health. All farmers could be considered to use conventional farm management approaches, breeding and fattening sheep and cattle.

The methodological approach to the interviews incorporated ethnographic approaches, using participant observation, immersive listening and “being-there” (aligning with the concept of Dasein in the phenomenology of Heidegger). Often beginning with a cup of tea, I would ask a combination of open and closed questions, getting to know the farmers and gaining an understanding of the farm and their farming practices. The conversations would continue as we walked or drove around the farm, discussing their observations of the farming system. Stopping in a paddock, I would shift the conversation to focus on interactions with, and experience of, the soil.

Participants were then explained the technology and offered to listen to the sound of the soil through headphones. The technology utilised was a Jez Riley French JrF c-series+ 'ecoutic' adapted contact microphone with probe, connected via an XLR impedance adaptor to a Zoom F3 field recorder (Figure 1). The 'ecoutic' adaptation of the contact microphone is suitable for use in ecoacoustic research.

In the phenomenological interview (e.g. Høffding & Martiny, 2016), the interviewee as the subject of research can themselves produce an account of their world. Hence the acoustic wave, as a characteriseable and analyisable sound, becomes secondary to the exploration of the farmers subjective, ‘lived experience’ of hearing this sound.

Holes were dug, the soil examined in our hands and worms counted as the discussions shifted to hypothesising about why such a noise would be audible (albeit through a special microphone) from the soil. Combining physical touch with visual assessment and listening aligns with sensory ethnology approaches (Drysdale & Wong, 2019), which use the senses as a subject of study and a tool for conducting fieldwork to understand human experiences.

Source (author, 2025)
Figure 1: Listening to the soil in-situ on farm in New Zealand

3 DISCUSSION

Perception is the organization, identification, and interpretation of sensory information to make-sense-of information or an environment (Schacter, 2011). Perception is not only the passive receipt of these signals, but it is also shaped by the recipient's learning, memory, expectation, and attention. In this case, nearly all farmers had little conception of what the soil may sound like, nor even an expectation that there would be a sound. Hence when hearing the soil for the first time, there was little contextual information from which to draw description. As the lived experience of listening to the soil is mediated through technology, given there is the need for a technological extension to one's auditory perceptual system to hear anything, I hypothesised that participants may have felt there was a technological barrier between them and the soil. Yet during onsite visits this seemingly played little role in perception of the soil sound, with all participants feeling that it was indeed the soil they were listening too, rather than a technological derivative.

Without exception hearing the sound through the headphones sparked a positive and curious, albeit occasionally bemused, response. Tellingly, after initially lacking words to describe the sound or the experience of listening to the soil, participants began to utilise their pre-existing knowledge of the soil system to imagine what could be happening for such a sound to be produced. In earlier conversation, all participants felt the soil was alive despite not all actively managing with soil life in direct consideration. Descriptions of the sound began to reflect the assertion of living soil, including "a worm head-butting the needle" and "an engine room of soil micro-organisms chewing and moving".

Conservation and restoration issues commonly stem from social problems (Moon & Blackman, 2014), hence there is the need for greater communication between the natural and social sciences. My philosophical perspective as a social researcher, in this case, was an eco-phenomenological one. Interested in exploring how human experience is intertwined with the natural world, focusing on the embodied, sensory, and existential aspects of human-nature interactions. Suggesting the soil sound as co-evolved, but also farmers and the soil operating in a co-constitutive manner, shaping and inform one another.

In this framework, experience is deeply contextual and shaped by the physical, emotional, and sensory aspects of nature (Schweitzer et al., 2018). Yet the epistemologies in modern farming systems, I came to realise, have long been post-phenomenological. By this I mean that lived experience, or learning, is regularly mediated by technology. Whilst not in the same manner as listening to the soil, farmer understanding of soil has long been informed by physical and chemical tests performed in laboratories, with results often being accompanied by the quantities of appropriate fertiliser to apply.

During interviews there was curiosity amongst farmers to listen to different paddock which they knew had different soil structures or deemed healthier. However, upon asking if this would be something they would incorporate into their usual practise, the unanimous response was that more quantitative, scientific information was needed to relate the sound to productivity, or to infer the need for a management change. Affordance is a concept from

ecological psychology which refers to the quality or property of an object that defines its possible uses or indicates how it can or should be used (Gibson, 1966). In this case the sound being the “object” of interpretation, without prior experience listening to this sound nor supporting information about its meaning, farmers had little perception of affordance - as may be the case with other signs and signals from the environment being observed and evaluated within the operating and optimisation of the farm system, their business.

This research aims to support the field of ecoacoustics by exploring how people experience the sound of the soil and hence how this science may be effectively communicated to potential users of this technology. This work also aligns more ecologically focused research with commentary on human-nature connection and coupled natural-human dynamics (Pijanowski et al., 2011). Understanding how people perceive and know nature, and the language they use in description, could have important implications for soil conservation policy and management.

A full analysis of interview transcripts is on-going, and hence this discussion remains provisional.

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