2024_69_Kew_LM: Fungi as bioindicators of belowground ecological recovery in woodland regeneration initiatives

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Fungi underpin numerous processes within soil. Their communities interact with virtually all aspects of soil biota and functions, and many fungi are sensitive to disturbance such as loss of tree cover, overgrazing or eutrophication. In nature recovery projects, progress is often measured with a focus on aboveground features alone (e.g., plant and animal species recovery) to monitor progress against conservation targets. The soil harbours the majority of the Earth's biodiversity and carbon, with fungi contributing a significant proportion of both, which means that they can potentially be used as bioindicators of ecological recovery in a way that is more comprehensive, systematic and precise than relying on aboveground features alone.

Ectomycorrhizal fungi play an essential role in tree nutrition and global carbon capture. They are expected to undergo a process of community assembly and succession as a newly-established woodland matures. A young regenerating woodland will harbour different ectomycorrhizal species at different levels of abundance compared with a mature or ancient woodland, and the degree to which the fungi in the young woodland resembles that of the mature one is a measure of its ecological trajectory towards the reference habitat to which it is being restored.

Hypothesis: the timing of ectomycorrhizal association, the initial species present, the sequence of arrival of other species, and the overall fungal species diversity will affect the ecological trajectory of the woodland, with possible effects on which plant communities establish and when. Like the evolution of organisms, mycorrhizal community ecology is a path-dependent process.

This project will compare ectomycorrhizal communities along chronosequences in a native woodland type, or along a 'regeneration front' (i.e., where a woodland is naturally regenerating from a central location into a non-woodland habitat). The use of eDNA as a monitoring tool to monitor belowground fungal communities is in its infancy, and characteristics of fungal recovery patterns are yet to be fully understood. The outcomes of this project would therefore be to:

(1) Refine our understanding of natural mycorrhizal dynamics in regenerating woodlands to inform woodland creation policy and habitat management.

(2) Develop and standardise approaches to using molecular-based identification of fungi in biomonitoring.

(3) Uncover patterns in fungal community assembly and succession that can potentially be developed into a 'Fungal Biodiversity Metric' to be integrated into preexisting metrics increasingly being used as natural capital markets develop, but which have thus far overlooked fungi (e.g., Defra's Biodiversity Metric 3.0).