Evaluating Peatland Restoration Using 3D X-ray Micro-Computed Tomography

Mr Jack R. Brennand[1], Dr Simon J. Carr[1], Dr Elizabeth Evans[2]
[1]University of Cumbria [2]NXCT, Manchester University

Website

Contact Details
Email: Jack.Brennand@uni.cumbria.ac.uk
Twitter: @brennand_j

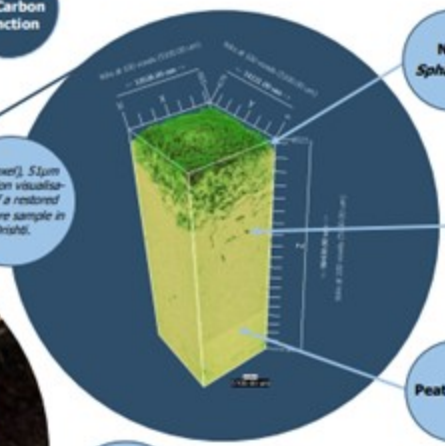
Introduction

Restoration aims to return peatlands to functional behaviour, enabling sequestration and the long-term storage of carbon. However, restored peatlands often fail to function effectively, and continue to be net carbon sources, rather than sinks. We need to understand the fundamental processes that govern peatland functionality if we aim to use peatland restoration as a key tool to meet the climate crisis.

Legend:

Structural Feature → Inference on Carbon Function

Samples are carefully extracted from 'degraded', restored, and 'pristine' peatlands for scanning using µCT.

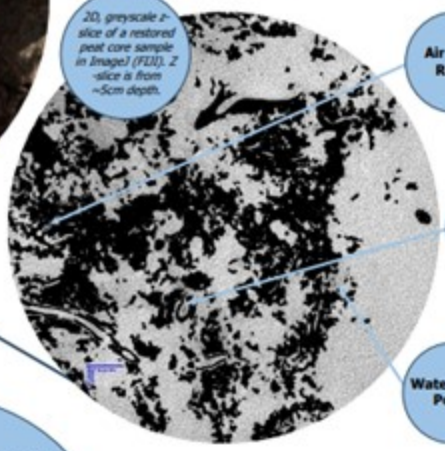


3D (voxel), 51µm resolution visualisation of a restored peat core sample in Drishti.

New *Sphagnum* → Carbon Sequestration

Air Filled Pores → Gaseous Exchange (CO_2 & CH_4)

Peat Matrix → Retarded Decay



2D, greyscale z-slice of a restored peat core sample in ImageJ (FIJI). Z-slice is from ~5cm depth.

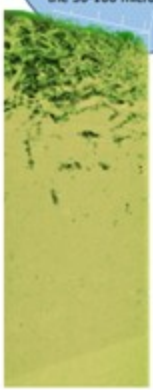
Air Filled Roots → Gaseous Exchange (CO_2 & CH_4)

Water Filled Roots → DOC & POC

Water Filled Pores → DOC & POC

µCT

µCT is a non-destructive imaging technique used to evaluate the 3D structure and composition of environmental materials. The attenuation of X-Ray energy enables the mapping of density variations within a sample, in this case to spatial resolutions in the 50-100 micron range.



Research

This project applies µCT for the first time to explore peatland restoration. Structural characteristics (pore-space, plant roots, and humification) are integrated with traditional laboratory and field methods (moisture content, bulk density, humification, LOI, pH, and redox potential) to derive a rich dataset from each sample.

Quantifying these properties will enable detailed examination of functional behaviour, particularly water and gas exchange that determine the health of restored peatlands and their carbon storage potential.

Laboratory subsampling of a restored peat core post µCT (MC, BD, humification, LOI, pH, and redox).

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