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Investigating the impact of shelterbelts on landscape hydrology

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Hedgerows and shelterbelts, once common place across the UK agricultural landscape have significantly decreased as a result of post-World War Two drive for agricultural intensification, coupled with EU incentives driven by the Common Agricultural Policy (CAP) reform. Simultaneously, rising storm frequency and intensity, believed to be brought about by anthropogenically-induced climate change has led to increasing incidences of flooding.

The cost of maintaining and building hard engineered solutions, particularly in small catchments is increasingly unattainable and thus Natural Flood Risk Management (NFRM) alternatives are being explored. UK policy on NFRM states that “working with natural processes” must be considered when designing flood mitigation measures. Central to the idea of nature-based solutions is the role of trees in the landscape. However, the effects of small tree features such as shelterbelts on downstream flooding is poorly understood because of a lack of knowledge regarding that effects of tree species type, age and position on the hydrology of different soil types. The work presented here is part of the Multi-Land project which aims to enhance agricultural productivity and ecosystem service resilience in multifunctional landscapes. Here, we specifically examine how trees in shelterbelts influence soil hydraulic properties and processes and quantify the potential role trees could have in flood mitigation.

Soil cores were taken from the BangorDIVERSE forest diversity experiment located in Abergwyngregyn, North Wales (53°14’15”N, 4°1’4”W). The experiment was established in March 2004 and consists of trees planted in monoculture and two and three species mixtures at a constant planting density of 10,000 stems ha-1. Root biomass and morphological characteristics was determined at three depths (0-10 cm, 10-20 cm and 20-30 cm) from single tree species plots of oak, beech, birch, ash, sycamore, chestnut, alder. Soil hydraulic properties were determined in each tree species plot along with a grassland control plot. In-situ measurements of hydraulic conductivity and soil infiltration rates were made using minidisk and dual-head infiltrometers and soil water retention curves determined on collected soil cores using the HYPROP system and modelling with HYDRUS 1D. Soil texture, water and organic matter content were also determined.

Species identity had a large impact on root biomass and morphology that could be correlated to rates of soil hydraulic conductivity. Spatial heterogeneity of hydraulic conductivity within the plots demonstrated the influence of tree species identity on infiltration rates and supported our hypothesis that trees reduce hydraulic conductivity compared with grassland control, despite a stony and highly porous shallow soil.