How threatened are UK trees by heat and drought waves?

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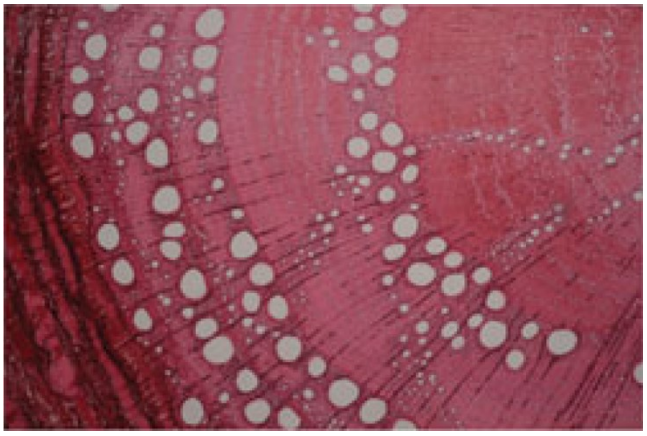

Dead Oak and an oak disk which shows the vessel structure of an oak

Dry and hot spells like the one which occurred in summer 2022 in the UK can lead to death of trees. High temperature spells will with certainty increase and climate forecasts suggest that drought spells will also become increasingly frequent. A maincause of tree death is that trees lose their ability to conduct water to their vital organsand in particular leaves. This phenomenon is called hydraulic failure. Under non-stressed conditions thin filaments of water are pulled in vessels from soil to the tree crown via the difference of so-called water potential - a stress exerted on the filaments from the leaves. When soil dries pulling water to the crown becomes increasingly difficult (soil water potential becomes increasingly negative) and the pull on the filaments may reach a point at which they rupture - or embolise - and provision of water to the leaves is strongly reduced. The pull (or water potential) in the tree conducting vessels at which the filaments rupture can be determined at the branch level using pneumatic methods. However not that much is known about how water potentials inside trees at various height levels vary temporally and in particular how these water potentials respond to heat and drought. This project will focus on testing and, depending on progress, applying a methodology to measure continuously water potential at different locations of the water path in a tree. The instruments the student will use are so-called psychrometers. Amongst others they will need calibration. The student will first have to establish and test the approach in the lab on small trees (saplings) and the instruments installed on oak trees in a forest plot in Washburn valley. The records of tree water potential variation and minima will then be compared with literature values of levels of hydraulic failure to determine the proximity of water potentials to critical water potentials when hydraulic failure starts to occur. These records may also be combined with concurrently measured sap flow and radial diameter growth to provide additional insight on response of water provision to the tree crowns under heat and drought anomalies.