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Can forest dieback and tree death be predicted by prior changes in wood anatomy?

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Climate warming is expected to amplify drought stress resulting in more intense and widespread dieback episodes and increasing mortality rates. Studies on quantitative wood anatomy and dendrochronology have demonstrated their potential to supply useful information on the causes of tree decline, although this approach is basically observational and retrospective. Moreover, the long-term reconstruction of wood anatomical features, strictly linked to the evolution of xylem anatomy plasticity through time, allow investigating hydraulic adjustments of trees.
In this study, we analyzed wood-anatomical variables in two Italian oak forests where recent episodes of dieback and mortality have been reported. We analyzed in coexisting now-dead and living trees the following wood-anatomical variables: annual tree-ring area, earlywood (EW) and latewood (LW) areas, absolute and relative (%) areas occupied by vessels in the EW and LW, EW and LW vessel areas, EW and LW vessel density and vessel diameter classification. We also calculated the hydraulic diameter (Dh) for all vessels measured within each ring by weighting individual conduit diameters to correspond to the average Hagen-Poiseuille lumen theoretical hydraulic conductivity for a vessel size.
Wood-anatomical analyses showed that declining and dead trees were more sensitive to drought stress compared to non declining trees, indicating different susceptibility to water shortage between trees. Dead trees did not form earlywood vessels with smaller lumen diameter than surviving trees but tended to form wider latewood vessels with a higher percentage of vessel area.
We discuss the results and implications focusing on those proved more sensitive to the phenomena of decline and mortality.