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Xylem porosity shapes sapwood characteristics and stem water use of temperate and boreal tree species

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Sapwood characteristics, such as sapwood area as well as thermal and hydraulic conductivity, are linked to species-specific hydraulic function and resource allocation to water transport tissues (xylem). These characteristics are often unknown and thus a major source of uncertainty in sap flow data processing and transpiration estimates because bulk rather than species-specific values are usually applied. Here, we analyzed the sapwood characteristics of fifteen common tree species in eastern North America from different taxa (i.e., angiosperms and gymnosperms) and xylem porosity groups (i.e., tracheid-bearing, diffuse- or ring-porous species). We quantified their sapwood area changes with stem diameter (allometric scaling) and thermal conductivity. We combined these measurements with species-specific values of wood density and hydraulic

conductivity found in literature and assessed the role of wood anatomy in orchestrating their covariation. Angiosperms (ring- and diffuse-porous species), with specialized vessels for water transport, showed steeper relation (scaling) between tree size and sapwood area in comparison to gymnosperms (tracheid-bearing species). Despite the variability in thermal conductivity between species, gymnosperms (angiosperms) were characterized by lower (higher) wood density and higher (lower) sapwood moisture content, resulting in non-significant differences in sapwood thermal conductivity between taxa and xylem porosity groups. Clustering of species sapwood characteristics based on taxa or xylem porosity could facilitate more accurate parameterizations of these attributes. When combined with an increasing number of sap flow observations, these findings can improve tree- and landscape-level transpiration estimates, leading to more robust partitioning of terrestrial water fluxes.