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Climate sensitivity of tropical trees along an elevation gradient in Rwanda

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Elevation gradients offer excellent opportunities to explore the climate sensitivity of vegetation. Here, we investigated elevation patterns of structural, chemical, and physiological traits in tropical tree species along a 1700–2700 m elevation gradient in Rwanda, central Africa. Two early-successional (Polyscias fulva, Macaranga kilimandscharica) and two late-successional (Syzygium guineense, Carapa grandiflora) species that are abundant in the area and present along the entire gradient were investigated. We found that elevation patterns in leaf stomatal conductance (gs), transpiration (E), net photosynthesis (An), and water-use efficiency were highly season-dependent. In the wet season, there was no clear variation in gs or An with elevation, while E was lower at cooler high-elevation sites. In the dry season, gs, An, and E were all lower at drier low elevation sites. The leaf-to-air temperature difference was smallest in P. fulva, which also had the highest gs and E. Water-use efficiency (An/E) increased with elevation in the wet season, but not in the dry season. Leaf nutrient ratios indicated that trees at all sites are mostly P limited and the N:P ratio did not decrease with increasing elevation. Our finding of strongly decreased gas exchange at lower sites in the dry season suggests that both transpiration and primary production would decline in a climate with more pronounced dry periods. Furthermore, we showed that N limitation does not increase with elevation in the forests studied, as otherwise most commonly reported for tropical montane forests.