Potential Influences of Epiphytes on Physiology of Tall Sitka Spruce in a Redwood Forest

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Epiphytes and their host trees epitomize commensalism, but the historical view of this relationship has ranged from semi-parasitic to mutualistic. While it is well documented that canopy epiphytes can increase nutrient availability to host trees and the ecosystem as a whole, how these interspecific interactions influence host tree physiology has received little attention. A number of tree species in the redwood forest produce aboveground adventitious roots and support a variety of epiphytes. Examples include bigleaf maple, vine maple, red alder, black cottonwood, Sitka spruce, and redwood.

Our study investigated the potential influence of epiphytes on host tree water status and physiology in tall (> 85 m) Sitka spruce trees at the Redwood Experimental Forest, Del Norte County. We hypothesized that host tree adventitious roots growing into moist epiphyte mats high above the forest floor uptake water, thereby reducing hydraulic constraints associated with lifting ground water against gravity. To test this hypothesis, we climbed trees and measured predawn water potential, leaf morphology, photosynthesis, internal CO_2 conductance, and respiration throughout crowns during the 2015-2016 winter when epiphyte mats were nearly saturated with water.

We found that tree predawn water potential values were higher than the gravitational component of water potential would predict, indicating water uptake from a "local" source within the crown. We also found that, presumably due to these relaxed water potential values high in tree crowns, leaf morphology, photosynthesis, internal CO_2 conductance, and respiration varied weakly with height compared to other tall conifer species. These findings are important to our understanding of redwood forest ecology, as they suggest that epiphytes have a larger influence on host tree physiology, and perhaps productivity, than typically considered. We recommend further research on these interspecific interactions to evaluate potential exchanges of water and carbon between host trees and epiphytes.