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STOMATAL AND ENVIRONMENTAL REGULATION OF WATER USE EFFICIENCY AND CARBON ISOTOPE DISCRIMINATION IN A TROPICAL FOREST CANOPY

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During 1990 and 1991, we studied how the regulation of carbon isotope composition ($\delta^{13}C$) in leaves of canopy trees is partitioned between variations in photosynthetic capacity (A_{max}), stomatal conductance (g_s), and the isotopic compositions of the source CO_2. A crane equipped with a gondola and a stationary tower were used to gain access to the canopies of 40-m tall, semi-evergreen forests near Panama City and on Barro Colorado Island, respectively. Photosynthetic gas exchange, water relations characteristics, and transpirational sap flow were measured simultaneously in the upper branches of emergent trees and at different heights within the same trees. $\delta^{13}C$ in exposed upper leaves ranged between -26.7 and -29‰ during the wet season. $\delta^{13}C$ values of the same species were 1 to 3‰ less negative during the dry season, indicating that intrinsic water use efficiency was higher. *Luhea seemannii* exhibited the most negative $\delta^{13}C$ values while *Ficus insipida* exhibited the most positive values. In *Virola surinamensis,* $\delta^{13}C$ varied from -36‰ lower in the canopy to -28.5‰ in the upper canopy. About 30% of this variation was attributable to differences in the $\delta^{13}C$ of the source CO_2 and the remaining 70% to internal physiological factors. Gas exchange measurements revealed that variation in foliar $\delta^{13}C$ among canopy species was attributable to variation in both A_{max} and g_s. These contrasting mechanisms for variation in $\delta^{13}C$ have different ecological implications.