Applying the West, Brown, and Enquist Fractal Branching Model on Palo Verde Trees

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Palo Verde trees (Parkinsonia microphylla) are one of the most unique trees native to Arizona in which photosynthesis occurs both through its small, transpiration-reduction adapted leaves and its green trunk. However, because of their multi-trunked nature, the branching patterns of these trees seem to be erratic, which is why I wanted to see whether the West, Brown, and Enquist (WBE) fractal branching model, a model that predicts scaling exponents relating to both the internal vascular and external branching networks of a tree, could be applied to such distinctive trees. Through data collection of two undisrupted palo verde trees in Coronado National Forest's Sabino Canyon by measuring hundreds of circumferences and lengths of a tree's branches, scaling exponents were calculated through a series of equations. The branch-level radius scaling exponent of Tree 1 fit within the range of 0.51-0.72, meaning that the tree is similar in terms of branching pattern and radius scaling exponent of five different tree species (maple, oak, pinyon, ponderosa, and balsa), but not length scaling and estimated metabolic rate exponents. However, Tree 2's values for all three scaling exponents don't fall within the ranges and thus, Tree 2 is not similar in terms of all three scaling exponents and branching pattern. Overall, all scaling exponents calculated did not match the exponents as defined by the WBE model. By being able to predict the external branching pattern of a palo verde tree, not only can the general shape of a tree be determined, but so can the amount of leaves. By calculating how much carbon fluxes in a singular leaf, an entire tree's carbon dioxide absorption can be calculated, aiding as a tool to help resolve many global environmental issues such as ocean acidification.

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