**Literature Review**

We conducted a literature search from November 9, 2020 to January 18, 2021 using the Google Scholar search engine (scholar.google.com). We used the search terms “stem photosynthesis,” “bark photosynthesis,” “bark conductance,” and “green stem” to find papers describing stem photosynthesis, and the terms “stem water uptake,” “bark water uptake,” and “bark conductance” to find papers describing bark water uptake. The search was conducted periodically throughout this time frame by all co-authors, and all unique papers that provided evidence of stem photosynthesis, bark conductance, or bark water uptake were entered in a single spreadsheet. At the end of the search, all observations that did not record values of stem photosynthesis, bark conductance, or bark water uptake were excluded (6 papers), resulting in a total of 126 papers.

For each paper we recorded the location name, latitude and longitude, whether the data were collected in the field or a greenhouse, and the ecosystem type where the field data were collected. We also recorded the species name and family, whether net CO2 uptake, CO2 reassimilation, bark conductance, or stem water uptake was recorded, and the values of each flux for all species.

**Stem Photosynthesis in the China Plant Trait Database**

We utilized the China Plant Trait Database categorization of stem photosynthesis to address how prevalent stem photosynthesis might be across plant families (Prentice et al. 2011, Wang et al. 2017, Wang et al. 2018). This database consists of information about 1215 species spanning 122 sites across temperature, rainfall, and elevational gradients. Stem photosynthesis was assessed qualitatively by the presence of green. Stem photosynthesis was only assessed on at least second year growth on mature individuals to reduce bias of green stems in young individuals and stems. For a species to be considered to have stem photosynthesis the trait had to be prevalent across numerous individuals and stems on an individual plant (Sandy Harrison *pers. comm.*). While there was no precise size limit to this process, this classification likely represents a conservative estimate of stem photosynthesis. This yielded 719 distinct species with a stem photosynthesis classification, 125 with stem photosynthesis and 594 without stem photosynthesis.

**Whittaker Plots**

We mapped the occurrence of woody stem photosynthesis and bark water uptake in climatic niche space using Whittaker biome classifications (Whittaker 1962). Whittaker plots were created using the ‘plotbiomes’ package (Stefan and Levin (2019) in R v. 4.0.3 (R Core Team 2020). Mean annual precipitation and temperature data were derived from the WorldClim database (Fick and Hijmans 2017). We created two figures that plotted (1) occurrences of bark photosynthesis, conductance, and water uptake from our literature review data, and (2) occurrences of stem photosynthesis from two datasets that surveyed the flora of China (Prentice et al. 2011, Wang et al. 2017, Wang et al. 2018). For the literature review plot, we grouped observations according to the following categories: only bark photosynthesis was observed (including both net CO2 uptake and CO2 reassimilation), bark photosynthesis and bark conductance were both observed, only bark conductance was observed, and bark water uptake was observed. For the Chinese Flora dataset, we plotted observations based on the “stem photo” trait and grouped observations where stem photosynthesis was recorded as present (“yes”) and those where stem photosynthesis was recorded as absent (“no”).

**Phylogenetic methods**

Our phylogenetic signal analysis was done using trait data (“stem photo”) from two large datasets that are publicly available in the TRY Database: “Chinese Traits” (Prentice et al. 2011) and “The China Plant Trait Database” (Wang et al. 2017, 2018). These two datasets were merged and cleaned to include only woody species, (i.e., species categorized as erect dwarf shrub, low to high shrub, liana, prostrate dwarf shrub, small tree, and tree), and we used unique records only. This produced a dataset of 686 woody species. We checked that the species names and families were correct by using the ‘TPL’ function of the package ‘Taxonstand’ (Cayuela et al. 2019) in R v. 4.0.3 (R Core Team 2020). We then used the package ‘V.Phylomaker’ (Jin and Qian 2019) to obtain a phylogenetic tree of 685 species, as one taxon failed to bind to the tree.

To map the trait “stem photo”, a binary trait with “yes” or “no” as the trait values, we used R v. 4.0.3 (R Core Team, 2020) to visualize the phylogenetic tree and randomly resolve polytomies using the ‘multi2d’ function in the package ‘ape’ (Paradis et al. 2004, 2018). We then used the ‘simmap’ function from the ‘phytools’ package (Revell 2012) to map the discrete states “yes” and “no” onto the phylogenetic tree. We used Pagel’s λ (Pagel 1999) to test for phylogenetic signal in “stem photo” using the function ‘fitDiscrete’ from the ‘geiger’ package (Harmon et al. 2020), and specified an equal rates model. Pagel’s λ detects if the shared evolutionary history of the species produces the pattern of trait similarity observed in the data (Pagel, 1999). As the ‘fitDiscrete’ function does not allow for a significance test to be run, we employed a randomization test in which 999 trees with shuffled tips were created and we compared our observed λ value with this population of random λ values.

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