

Tropical tree diversity enhances light capture through crown plasticity and spatial and temporal niche differences

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Appendix B: Supplementary methods for the analysis of hemispher- ical photographs.

We measured light availability at ground level at the center of each of the 88 subplots with hemispherical photographs. Pictures were taken in September 2009 at 1m above ground with a Nikon Coolpix 990 digital camera and a Nikkor E8 7.2mm fish-eye adaptor. Three photographs (LS2-3, T3-1 and A2-1) were removed from the analysis because low branches blocked a substantial part of the hemisphere and biased measurement. To isolate treatment effects and because plots with different diversity treatments are adjacent, we evaluated light availability inside a 45 degree cone originating at the point of measurement, which is standard practice in forest simulator models (Canham *et al.*, 2004). All photographs were analyzed using the GLA software (Frazer *et al.*, 1999) that computes the gap light index (GLI), which is the percentage of incident photosynthetically active radiation (PAR) that is transmitted through gaps in the forest canopy to a specific location in the understory over a given time period (Canham *et al.*, 1988a). GLA requires a discretization of the sky hemisphere with a user defined resolution. We set the number of altitude and azimuth grids to 45 and 90, respectively. Differences in leaf phenology among species precluded calculations

over a whole growing season from our photographs that capture the quantity and distribution of foliage at one point in time only. We adjusted solar and meteorological parameters to calculate GLI for September only based on 30-year normals from the closest weather station located at Barro Colorado Island (BCI) (Table B1).

To calibrate the light model (see appendix B), another 91 photographs taken in December, 25th 2007, March, 21st 2008 and June, 17th 2008 were analyzed. We used the same methods except that solar and meteorological parameters were adjusted accordingly (Table B1).

Table B1. Solar and meteorological parameters used in the analysis of hemispherical photographs with the GLA software.

	March	June	September	December
Clear Sky transmission coefficient	0.65	0.65	0.65	0.65
Beam fraction	0.530	0.251	0.277	0.373
Spectral fraction	0.530	0.351	0.362	0.416
Cloudiness index	0.564	0.381	0.399	0.463

Literature cited

- ²⁴ Canham, C.D., LePage, P.T. & Coates, K.D. (2004). A neighborhood analysis of canopy tree competition: effects of shading versus crowding. *Canadian Journal of Forest Research-Revue Canadienne De Recherche Forestiere*, 34, 778–787.
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