 DOI: 10.1086/679576

Appendix B from X. Xiao et al., "A Strong Test of the Maximum Entropy Theory of Ecology"

(Am. Nat., vol. 185, no. 3, p. E70)

Alternative Scaling between Diameter and Metabolic Rate

While we converted diameter (D) to metabolic rate (B) with $B \propto D^2$ in our analyses, alternative relationships between diameter and metabolic rate have been proposed. Specifically, it has been suggested that the aboveground biomass of tropical trees is a function of diameter, wood density, and forest type (Chave et al. 2005), while the relationship between aboveground biomass and metabolic rate is a biphasic mixed-power function (Mori et al. 2010). Here, we demonstrate that adopting this alternative scaling relationship does not quantitatively change our results.

We compiled species-specific wood densities (wood-specific gravity [WSG]) from previous publications (Reyes et al. 1992; Chave et al. 2009; Zanne et al. 2009; Wright et al. 2010; Swenson et al. 2012). Since WSG information is not available for every species, we included only communities of tropical forest where no less than 70% of individuals belonged to species with known WSG to ensure the accuracy of our analysis. This criterion was met by five communities (Barro Colorado Island, Cocoli, plots 4 and 5 in La Selva, and Luquillo) of all 60 that we examined. Individuals in these communities for which WSG information was not available were assigned average WSG values across all species in the WSG compilation.

We obtained the metabolic rate of each individual using the alternative scaling relationships specified in Chave et al. (2005) and Mori et al. (2010). The maximum entropy theory of ecology (METE) was then applied to each community following the steps described in "Methods," and its predictions were compared with the observed values for the individual size distribution (ISD), the size-density relationship (SDR), and the intraspecific ISD (iISD; figs. B1–B5). Although the patterns differ slightly in shape with metabolic rates obtained from the alternative method, the explanatory power of METE for each pattern does not change qualitatively, that is, METE characterizes the ISD with high accuracy but is unable to explain much variation in the SDR or the iISD regardless of the method used to calculate metabolic rate (compare figs. B1–B5 with corresponding communities in the supplementary figures).

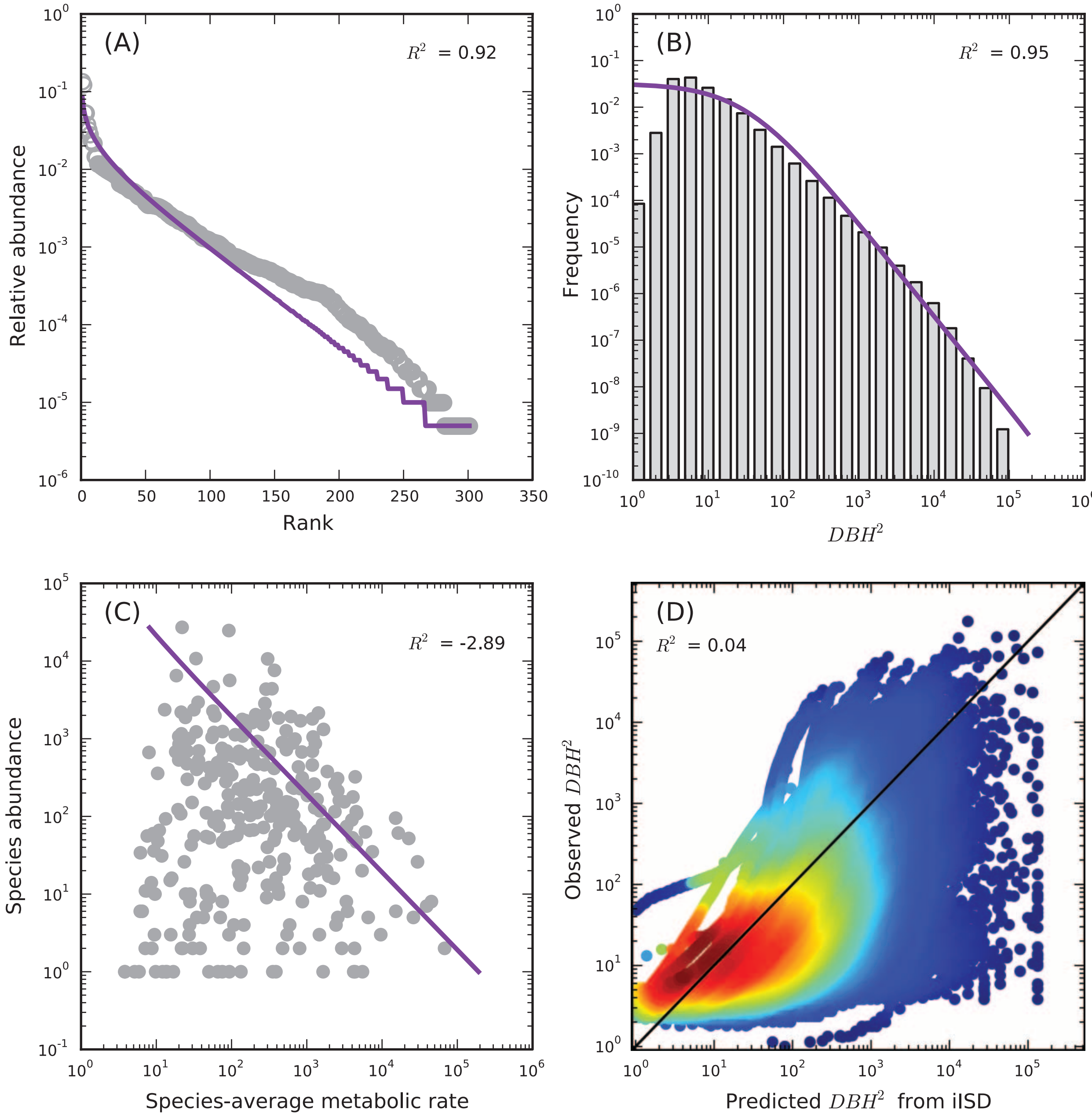

Figure B1: Maximum entropy theory of ecology's (METE's) predictions plotted against observed values for the species abundance distribution, which remains unchanged (*A*); the individual size distribution (ISD; *B*); the size-density relationship (SDR; *C*); and the intraspecific ISD (iISD; *D*) for Barro Colorado Island. Here, the metabolic rate was obtained with the alternative scaling method, which slightly changes the shape of the ISD, the SDR, and the iISD without significantly impacting the explanatory power of METE. DBH = diameter at breast height.

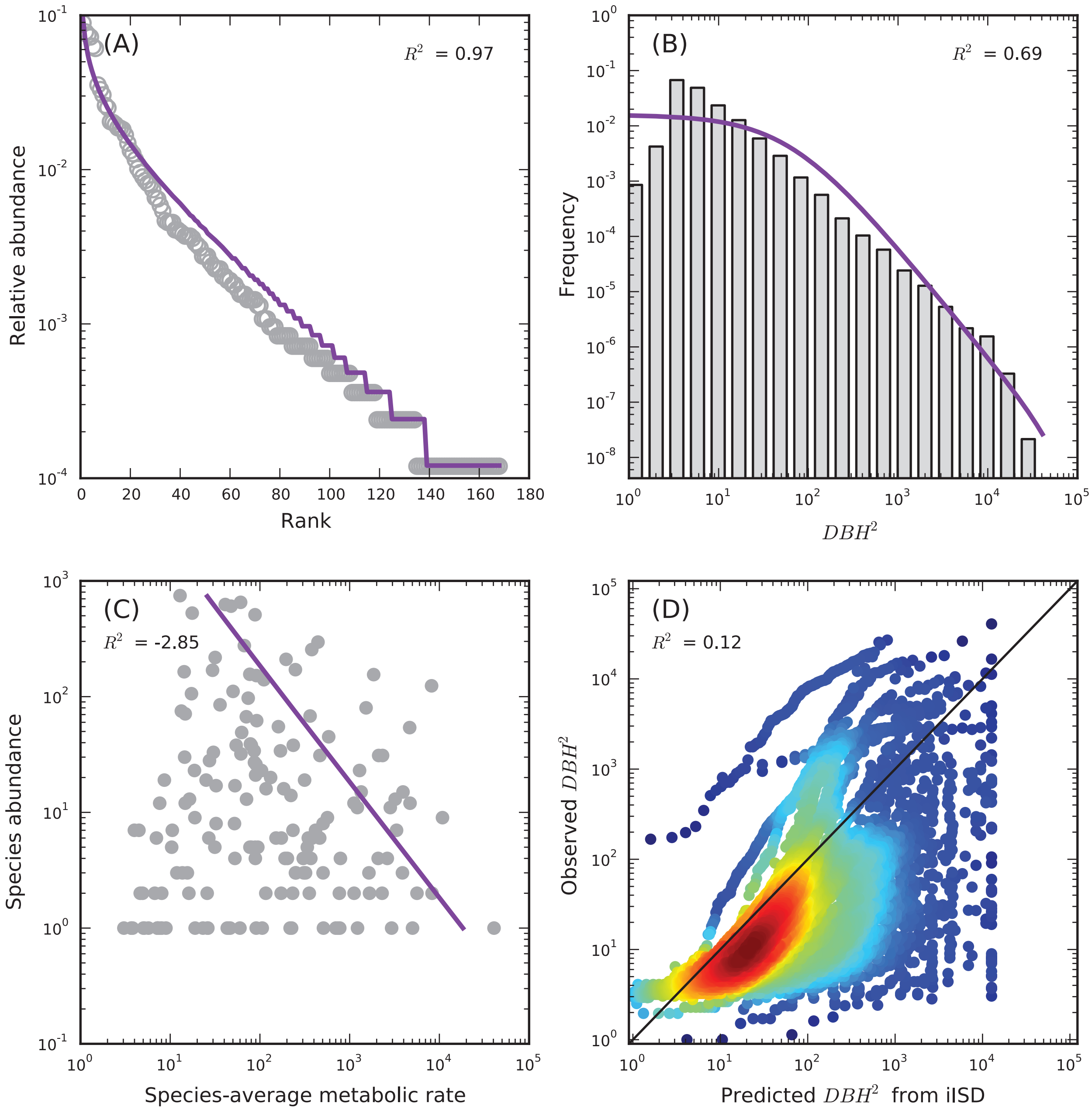

Figure B2: Maximum entropy theory of ecology's predictions plotted against observed values for the species abundance distribution (*A*), the individual size distribution (ISD; *B*), the size-density relationship (*C*), and the intraspecific ISD (iISD; *D*) for Cocoli, with the alternative scaling method used for metabolic rate. DBH = diameter at breast height.

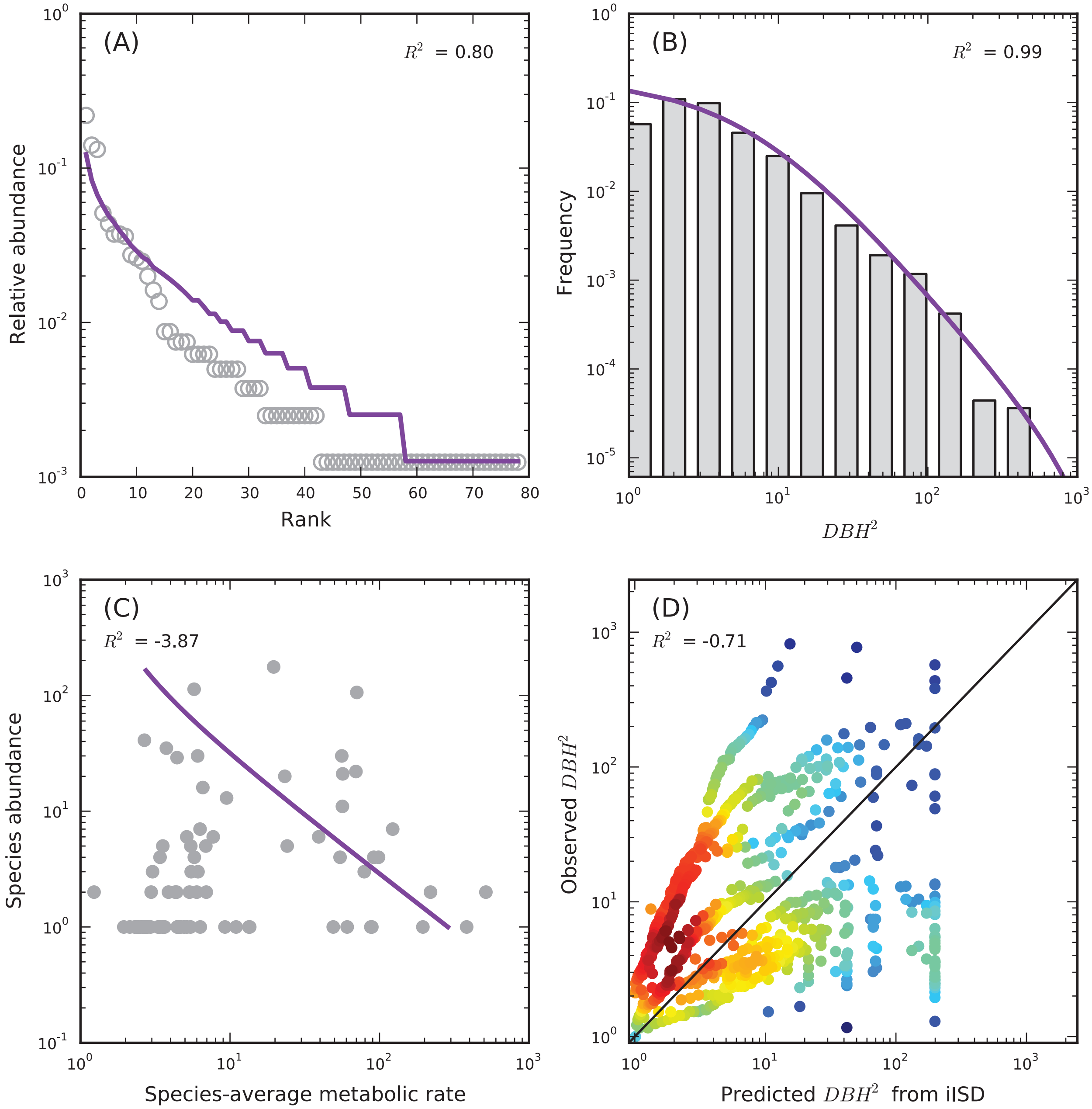

Figure B3: Maximum entropy theory of ecology's predictions are plotted against observed values for the species abundance distribution (*A*), the individual size distribution (ISD; *B*), the size-density relationship (*C*), and the intraspecific ISD (iISD; *D*) for plot 4 in La Selva, with the alternative scaling method used for metabolic rate. DBH = diameter at breast height.

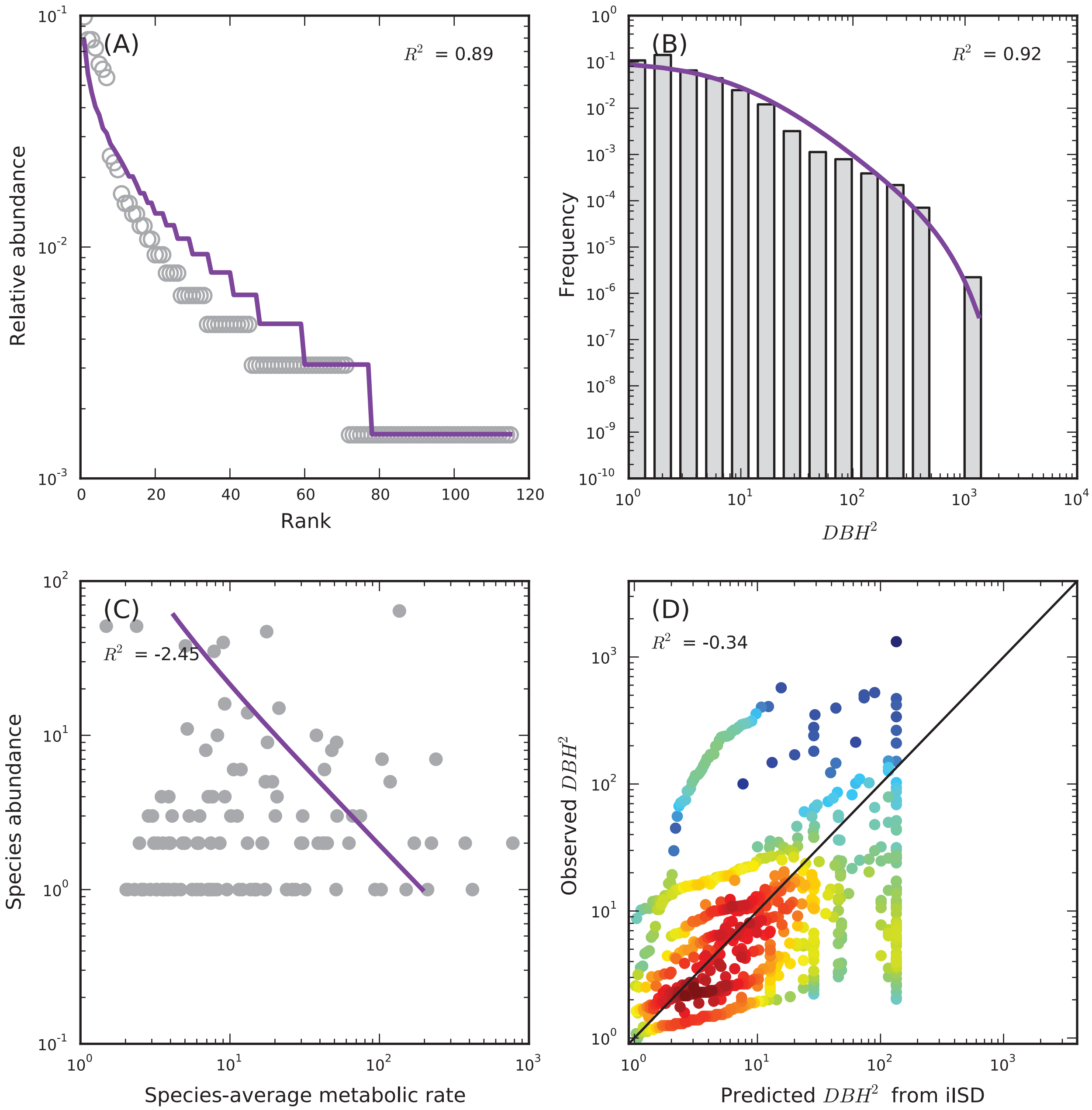

Figure B4: Maximum entropy theory of ecology's predictions plotted against observed values for the species abundance distribution (*A*), the individual size distribution (ISD; *B*), the size-density relationship (*C*), and the intraspecific ISD (iISD; *D*) for plot 5 in La Selva, with the alternative scaling method used for metabolic rate. DBH = diameter at breast height.

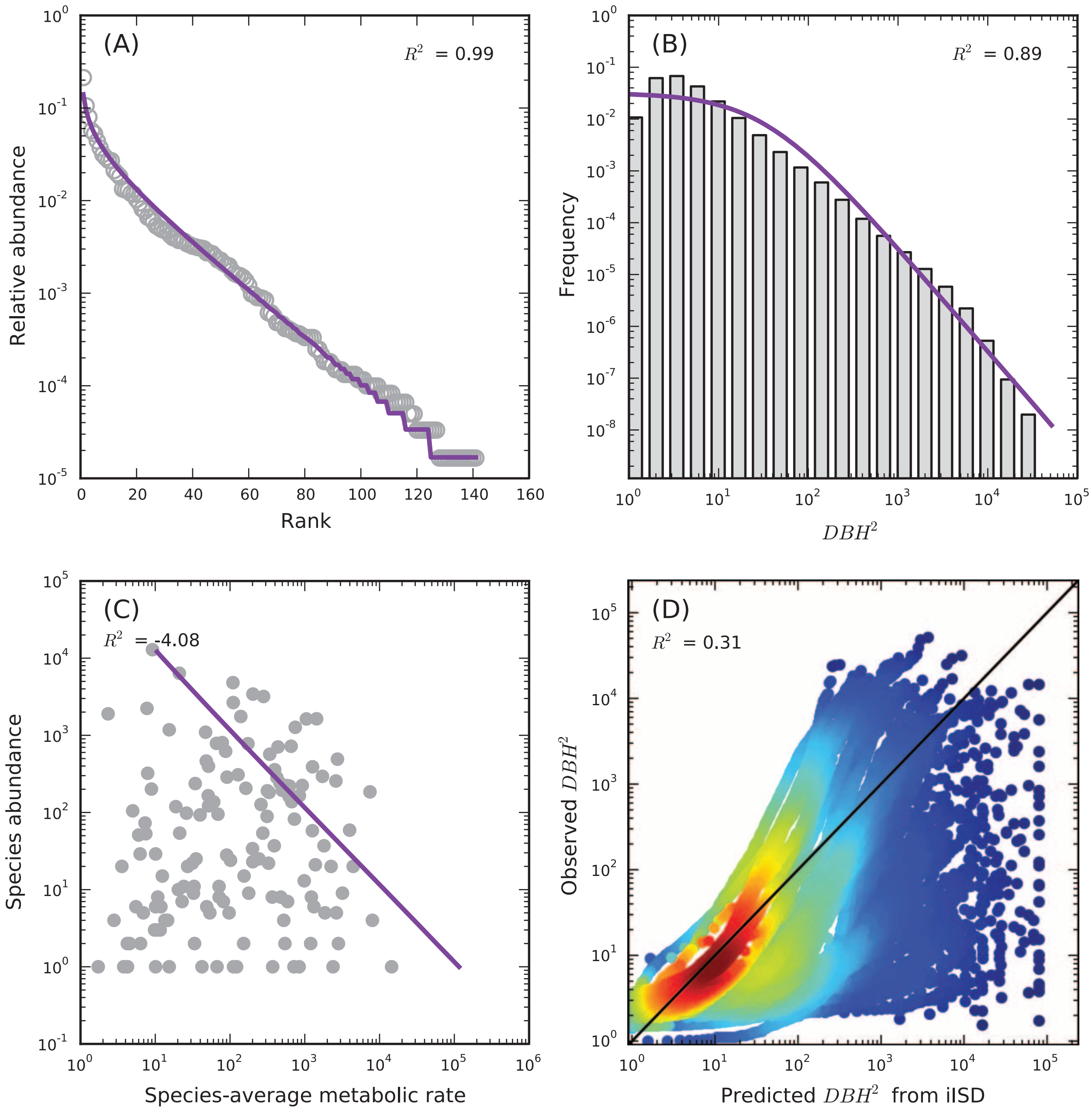

Figure B5: Maximum entropy theory of ecology's predictions plotted against observed values for the species abundance distribution (*A*), the individual size distribution (ISD; *B*), the size-density relationship (*C*), and the intraspecific ISD (iISD; *D*) for Luquillo, with the alternative scaling method used for metabolic rate. DBH = diameter at breast height.

Literature Cited Only in Appendix B

Chave, J., C. Andalo, S. Brown, M. A. Cairns, J. Q. Chambers, D. Eamus, H. Fölster, et al. 2005. Tree allometry and improved estimation of carbon stocks and balance in tropical forests. Oecologia (Berlin) 145:87–99.

Chave, J., D. Coomes, S. Jansen, S. L. Lewis, N. G. Swenson, and A. E. Zanne. 2009. Towards a worldwide wood economics spectrum. Ecology Letters 12:351–366.

Mori, S., K. Yamaji, A. Ishida, S. G. Prokushkin, O. V. Masyagina, A. Hagihara, A. T. M. R. Hoque, et al. 2010. Mixed-power scaling of whole-plant respiration from seedlings to giant trees. Proceedings of the National Academy of Sciences of the USA 107:1447–1451.

Reyes, G., S. Brown, J. Chapman, and A. E. Lugo. 1992. Wood densities of tropical tree species. General Technical Report SO-88. Southern Forest Experiment Station, US Forest Service, US Department of Agriculture, New Orleans.

Swenson, N. G., J. C. Stegen, S. J. Davies, D. L. Erickson, J. Forero-Montaña, A. H. Hurlbert, W. J. Kress, et al. 2012. Temporal turnover in the composition of tropical tree communities: functional determinism and phylogenetic stochasticity. Ecology 93:490–499.

Wright, S. J., K. Kitajima, N. J. B. Kraft, P. B. Reich, I. J. Wright, D. E. Bunker, R. Condit, et al. 2010. Functional traits and the growth-mortality trade-off in tropical trees. Ecology 91:3664–3674.

Zanne, A. E., G. Lopez-Gonzalez, D. A. Coomes, J. Ilic, S. Jansen, S. L. Lewis, R. B. Miller, et al. 2009. Data from: Towards a worldwide wood economics spectrum. Ecology Letters 12:351–366, Dryad Digital Repository, http://dx.doi.org/10.5061/dryad.234/1.