

## **Supplementary Material**

Appendix 1 to *What constrains food webs? A maximum entropy framework for predicting their structure with minimal biases*

Francis Banville<sup>1,2,3</sup> Dominique Gravel<sup>2,3</sup> Timothée Poisot<sup>1,3</sup>

<sup>1</sup> Université de Montréal <sup>2</sup> Université de Sherbrooke <sup>3</sup> Quebec Centre for Biodiversity Science



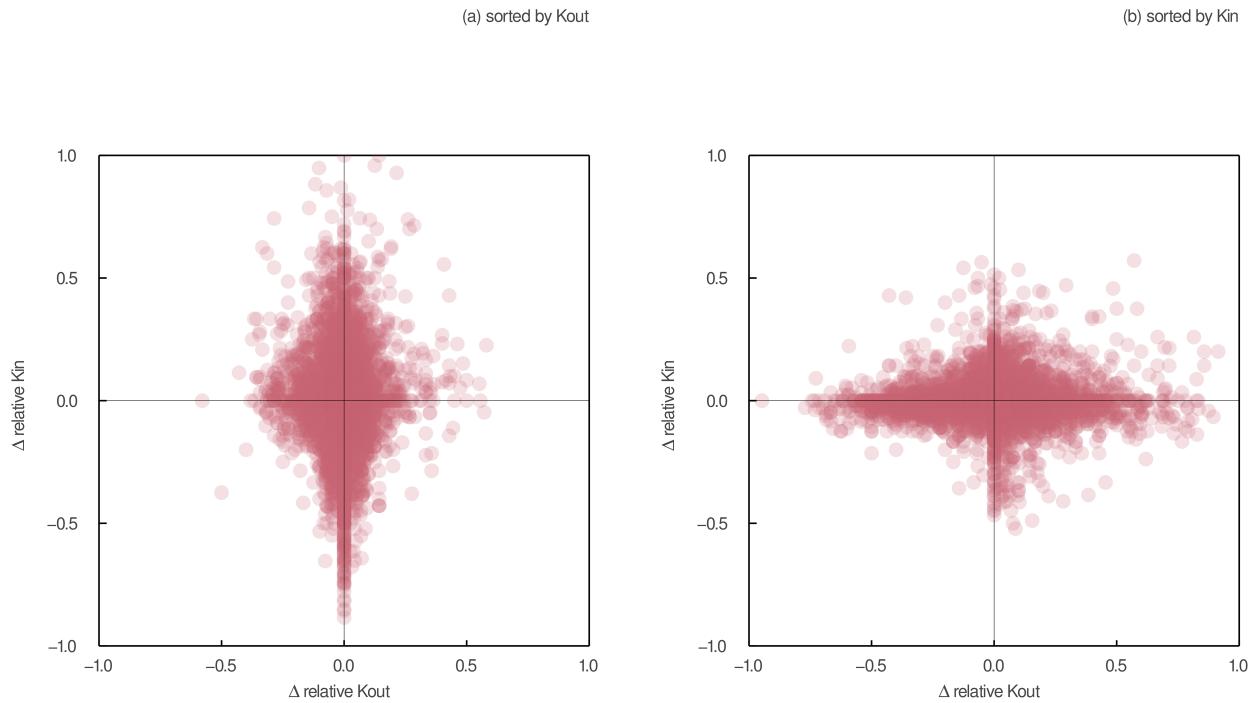


Figure 1: Difference between predicted and empirical values for the relative number of predators  $k_{in}$  and the relative number of prey  $k_{out}$  when species are ordered according to (a) their out-degree and (b) their in-degree. Empirical networks include most food webs archived on Mangal, as well as the New Zealand and Tuesday lake datasets (our complete dataset). The predicted joint degree sequences were obtained after sampling one realization of the joint degree distribution of maximum entropy for each network, while keeping the total number of interactions constant. In each panel, each dot corresponds to a single species in one of the networks.

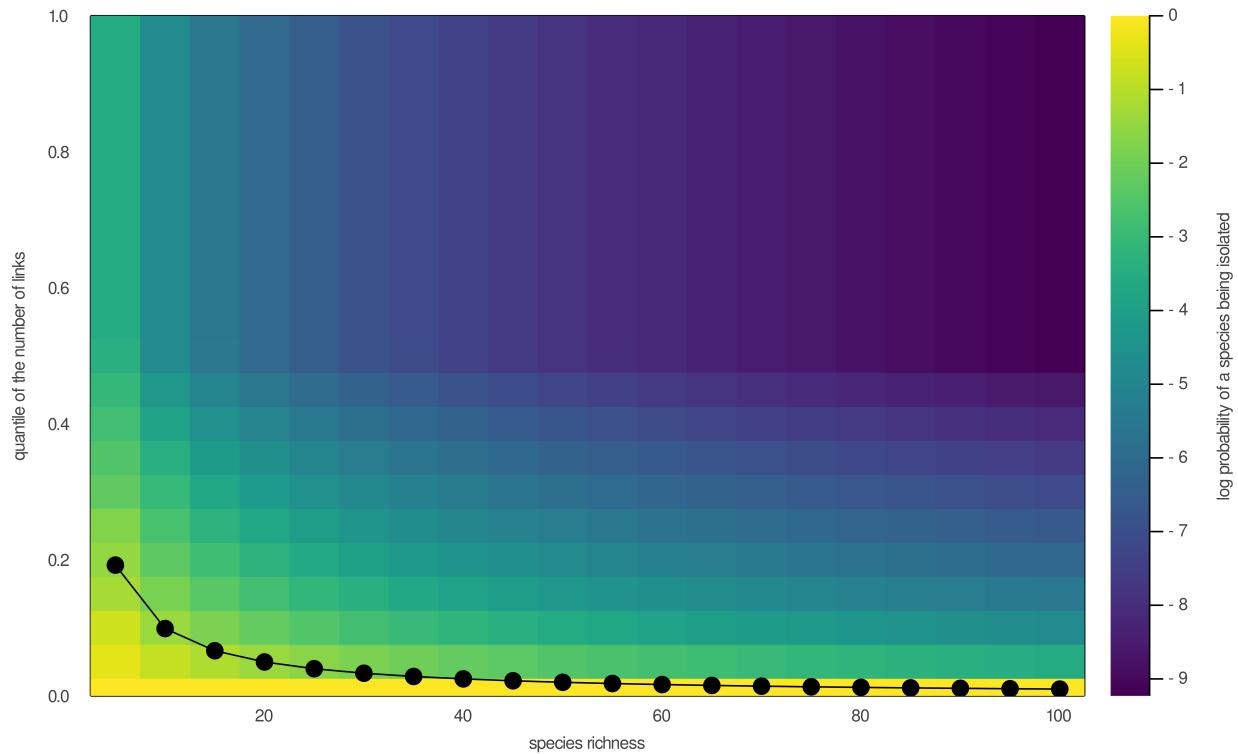


Figure 2: Probability that a species is isolated in its food web according to the degree distribution of maximum entropy. We derived many degree distributions of maximum entropy given a range of values of  $S$  and  $L$ , and plotted the probability that a species has a degree  $k$  of 0 (log-scale color bar). Here species richness varies between 5 and 100 species, by increment of 5 species. For each level of species richness, the numbers of interactions correspond to all 20-quantiles of the interval between 0 and  $S^2$ . The black line marks the  $S - 1$  minimum numbers of interactions required to have no isolated species.

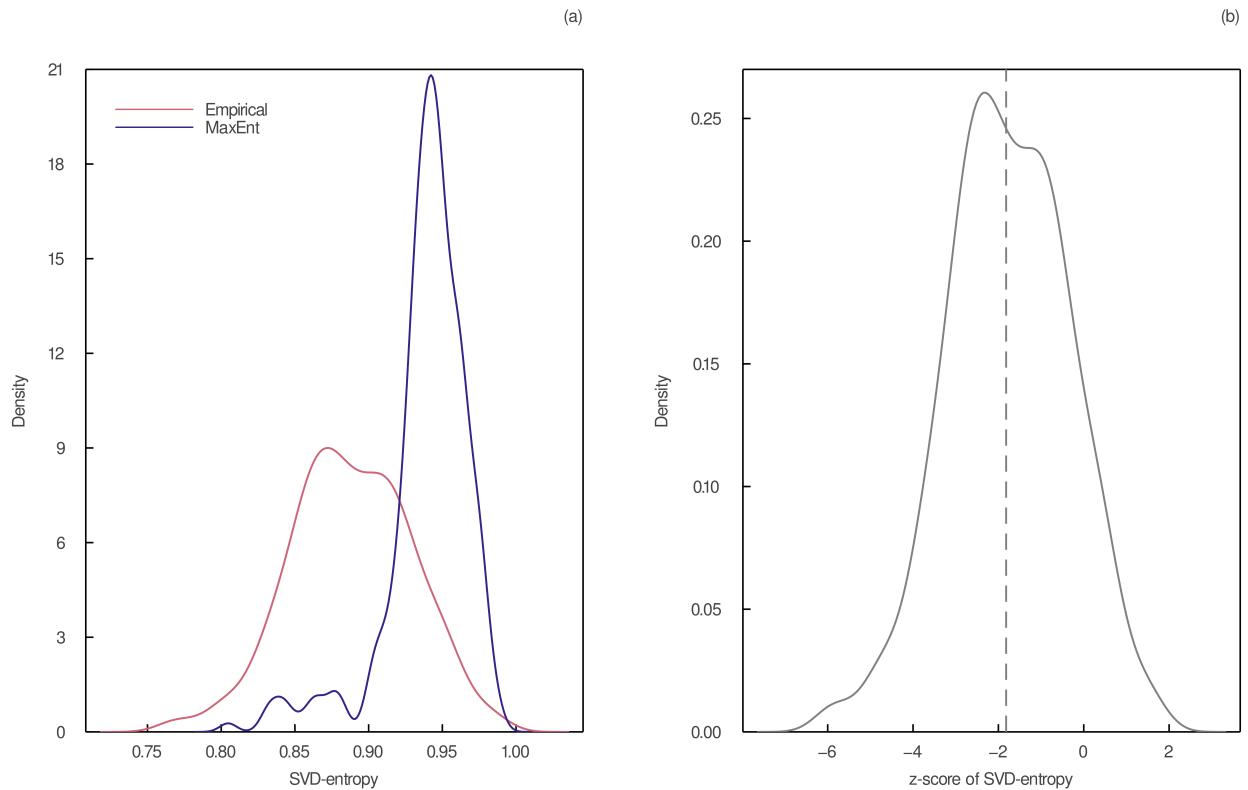


Figure 3: (a) Distribution of the SVD entropy of empirical and maximum entropy food webs. Empirical networks include most food webs archived on Mangal, as well as the New Zealand and Tuesday Lake food webs (our complete dataset). Maximum entropy networks were obtained using the type II heuristic MaxEnt model based on the joint degree sequence. (b) Distribution of z-scores of the SVD entropy of all empirical food webs. Z-scores were computed using the mean and standard deviation of the distribution of SVD entropy of MaxEnt food webs (type II heuristic MaxEnt model). The dash line corresponds to the median z-score.

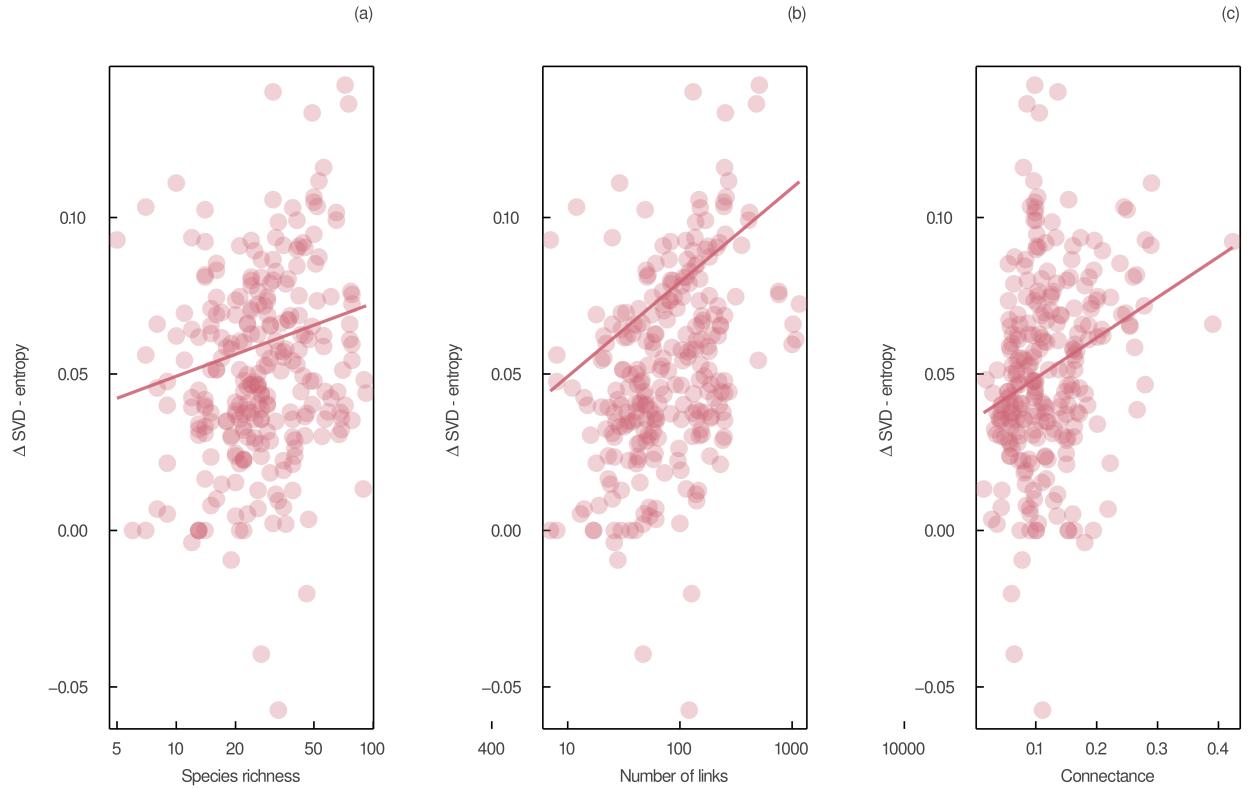


Figure 4: Difference in SVD entropy between maximum entropy and empirical food webs as a function of (a) species richness, (b) the number of interactions, and (c) connectance. Empirical networks include most food webs archived on Mangal, as well as the New Zealand and Tuesday Lake food webs (our complete dataset). Maximum entropy networks were obtained using the type II heuristic MaxEnt model based on the joint degree sequence. Regression lines are plotted in each panel.

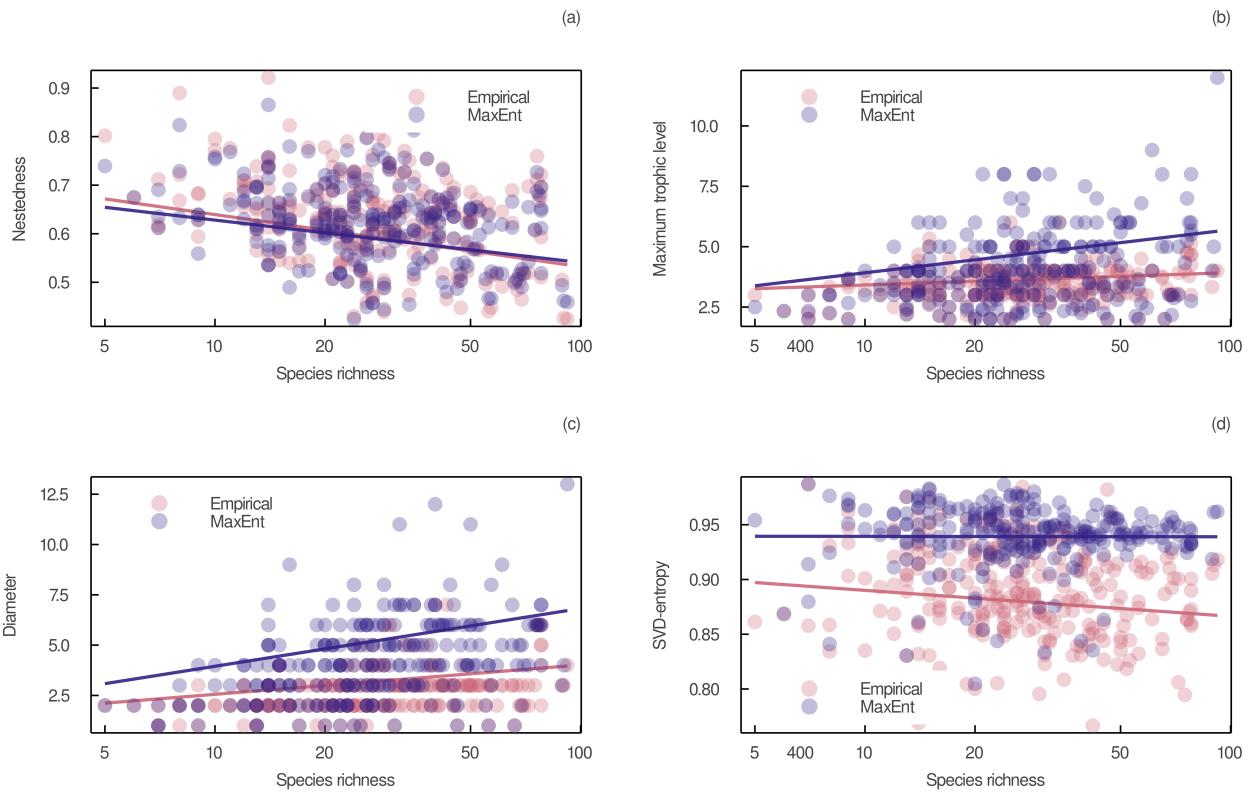


Figure 5: Structure of empirical and maximum entropy food webs as a function of species richness. Empirical networks include most food webs archived on Mangal, as well as the New Zealand and Tuesday Lake food webs (our complete dataset). Maximum entropy networks were obtained using the type II heuristic MaxEnt model based on the joint degree sequence. (a) Nestedness (estimated using the spectral radius of the adjacency matrix), (b) the maximum trophic level, (c) the network diameter, and (d) the SVD entropy were measured on these empirical and maximum entropy food webs and plotted against species richness. Regression lines are plotted in each panel.