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BayesianNetworks: a new tool for analysing ecological interactions

Studying species interactions is crucial for understanding ecosystem dynamics. However, obtaining accurate estimates of biotic interactions requires extensive field sampling over long periods, where more effort leads to more comprehensive estimates. To date, most empirical ecological studies are based on observational data which does not effectively incorporate sampling completeness into species interaction estimates. Yet, strong variation in sampling effort among species can greatly impact network structure as well as many other network parameters. Variation encountered across network structure and parameters can be a result of methodological bias rather than biological processes, hindering correct ecological interpretation. This underscores the need to consider uncertainty when dealing with unreliable ecological data. In a recent study, Young and colleagues (2021) proposed a Bayesian statistical framework that allows obtaining more robust estimates of network structure and ecological metrics from noisy observational data. The authors reconstructed plant-pollinator networks from observational data based on interaction likelihood. Building on the work of Young et al. (2021), we introduce a new open-source R package called "BayesianNetworks"that greatly facilitates data preparation, model fitting, and posterior model assessment for large numbers of interaction networks. This package incorporates the effect of varying sampling efforts on network reconstruction, as well as underlying preferences between interacting partners. The package will be made publicly available soon and is expected to facilitate the adoption of a more robust framework for the analysis of ecological networks. We illustrate the application of this R package using 46 plant-animal networks based on fruit-consumption visitation events with varying sampling efforts. For each network, we obtain Bayesian posterior estimates for all potential interactions and propagate these uncertainties into network descriptors. We demonstrate how this novel confidence-based approach allows obtaining more robust, complete, and insightful picture of the structure of ecological networks.

REFERENCES:

Young, J.-G., Valdovinos, F. S., & Newman, M. E. J. (2021). Reconstruction of plant–pollinator networks from observational data. Nature Communications, 12(1), 3911. https://doi.org/10.1038/s41467-021-24149-x

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