Temporal Turnover of Plant-Pollinator Interaction Networks

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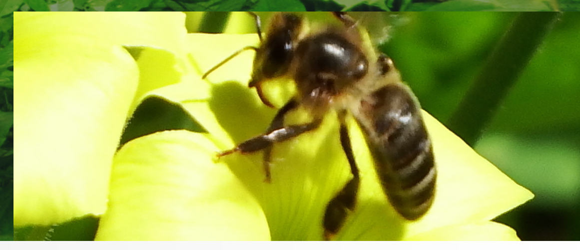


Dynamics of bee-flower interactions

Understanding how and why plant-pollinator networks (e.g. bee-flower interactions) vary over time is crucial in the conservation of pollinators, and in the continuation of their pollination services. Moreover, climate change can result in fluctuating flowering times, therefore affecting or driving turnover in plant-pollinator interactions. The structure of bee-flower interaction networks is likely to differ between seasons or even shorter timescales of weeks to months. However, this interaction turnover has been largely ignored by previous research on plant-pollinator networks, which assume a static picture of pollination networks.

I would like to find out...

- Does temperature, precipitation or humidity affect bee-flower interaction turnover?
- Does bee-flower interaction turnover differ between seasons?
- Does bee-flower interaction turnover of the tropics differ from those of the temperate regions?

Data

- *Species level:* 153 plant and 184 bee species were observed.
- *Interactions level:* 820 unique interactions and 2647 recorded interactions across 39 months.
- *Locations:* Cerrado, a tropical savanna and a subalpine habitat in the Gunnison National Forest.

Aim: To investigate the effect of climate on bee-flower interaction turnover.

Calculating turnover

In networks, nodes (species) are linked by edges (bee-flower interactions). Differences between networks are reflected by the Whittaker's dissimilarity index, β_{int}, given by:

$$\beta_{int} = \frac{a+b+c}{(2a+b+c)/2} - 1$$

where:

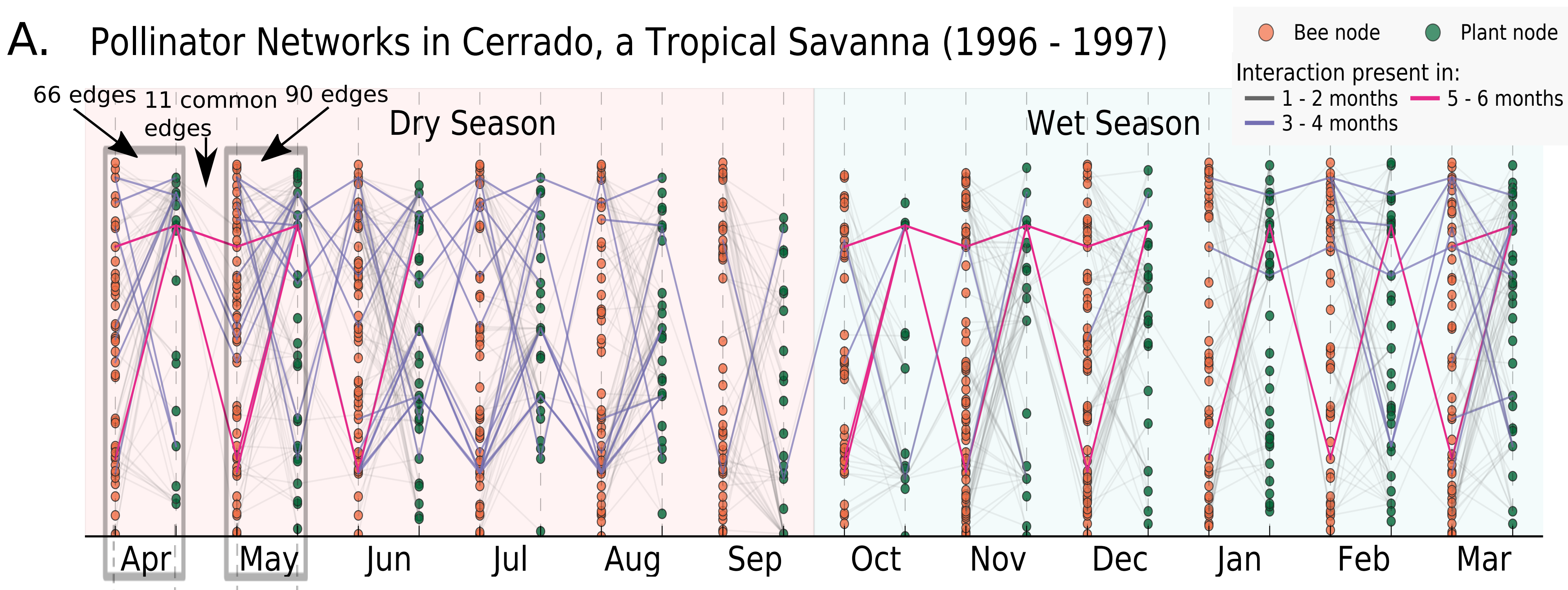
- a is the number of interactions shared between the two networks.
- b and c are the number of unique interactions in the two networks.

For example, when comparing between April and May networks in Figure A:

$$\beta_{int} = \frac{11+55+79}{(2\times 11+55+79)/2} - 1 = 0.859$$

β_{int} ranges from 0 to 1.
A higher β_{int} reflects a higher difference between monthly networks.

Preliminary Results



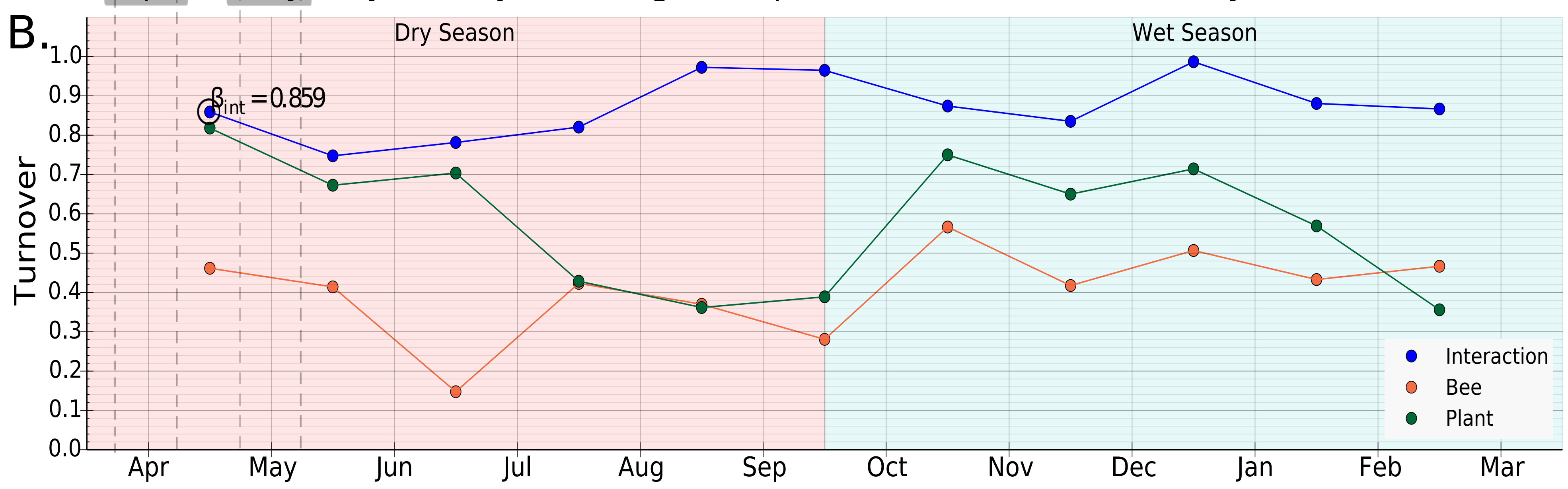


Figure A: Monthly bee pollinator networks from April 1996 to Mar 1997.
Figure B: Bee-flower interaction turnover and species turnover from April 1996 to Mar 1997.
Average monthly precipitation sum = 25.3 mm (Dry Season), 239.6mm (Wet Season)

Conclusions and Ongoing work

- Bee-flower interaction turnover is higher than ever reported before (CaraDonna, Petry, Brennan, et al., 2017).
- There are no significant differences between turnover within seasons and between seasons.
- Periodic pattern in turnover of bee-flower interactions is not primarily driven by species turnover.
- Currently determining if precipitation and temperature are strong drivers of bee-flower interaction turnover.

Possible challenges

- Insufficient data.
  However, β_{int} is rarely affected by small sample sizes.
- If climate does not affect bee-flower interaction turnover, other factors to be considered include body size and lifespan of bees.

References:
- CaraDonna, P. J., Petry, W. K., Brennan, R. M., et. al. (2017). Interaction rewiring and the rapid turnover of plant-pollinator networks. *Ecol. Letters*, 20: 385-394. doi:10.1111/ele.12740
- Simone, C.R., Simpson, B., Tidon, R., Neff, J., Pawar, S. (2015). Aseasonal pollinators connect seasonal modules in pollination networks from the Cerrado, a highly diverse seasonally dry neotropical savanna. [Not published]
- Poisot, T., Canard, E., Mouillot, D., Mouquet, N. & Gravel, D. (2012). The dissimilarity of species interaction networks. *Ecol. Letters*, 11, 564-575

Acknowledgements: Special thanks to M.C. BoaVentura and S. C. Cappellari for making their data set available for the analyses, as well as Samraat Pawar for his supervision and advice throughout this project.