Evolving in a tangled world

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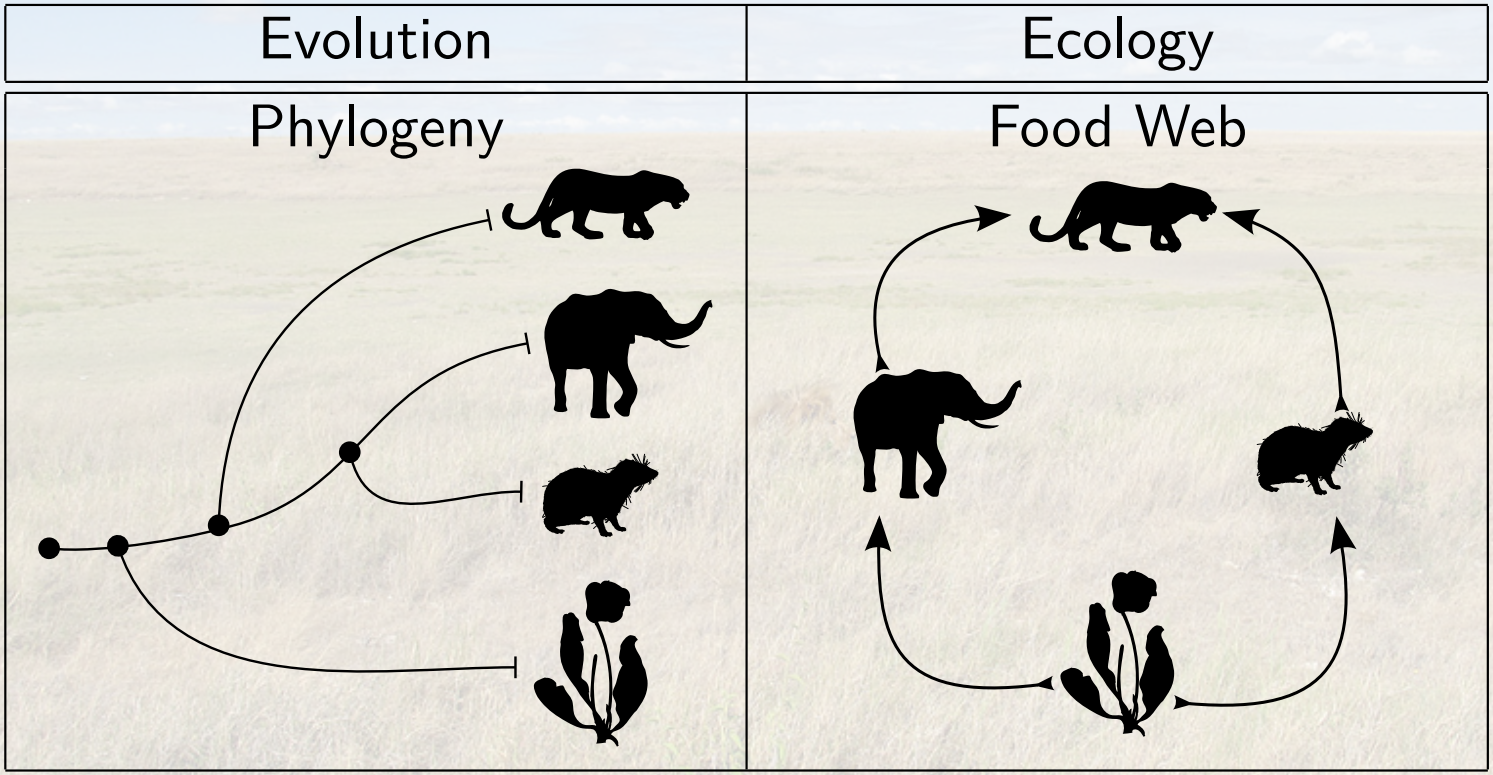
Why?

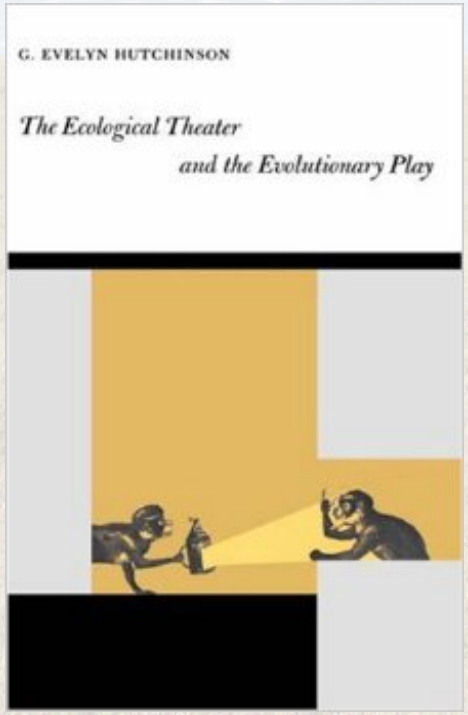


phylopics

pics from

Why?

The Theater and the Play



Ecology and Evolution occur on different time scales?

Why?

Although species evolve and diversify in a complex network of species interactions, current models of diversification typically ignore species interactions. Inference approaches basedon joint phylogenetic and species interaction data allow testing the degree to which species interactions are evolutionarily conserved (Ives and Godfray 2006; Rezende et al. 2007), but do not allow analysing the effect of species interactions on diversification.
Helen Morlon - Ecology Letters (2014) ***17****: 508-525*

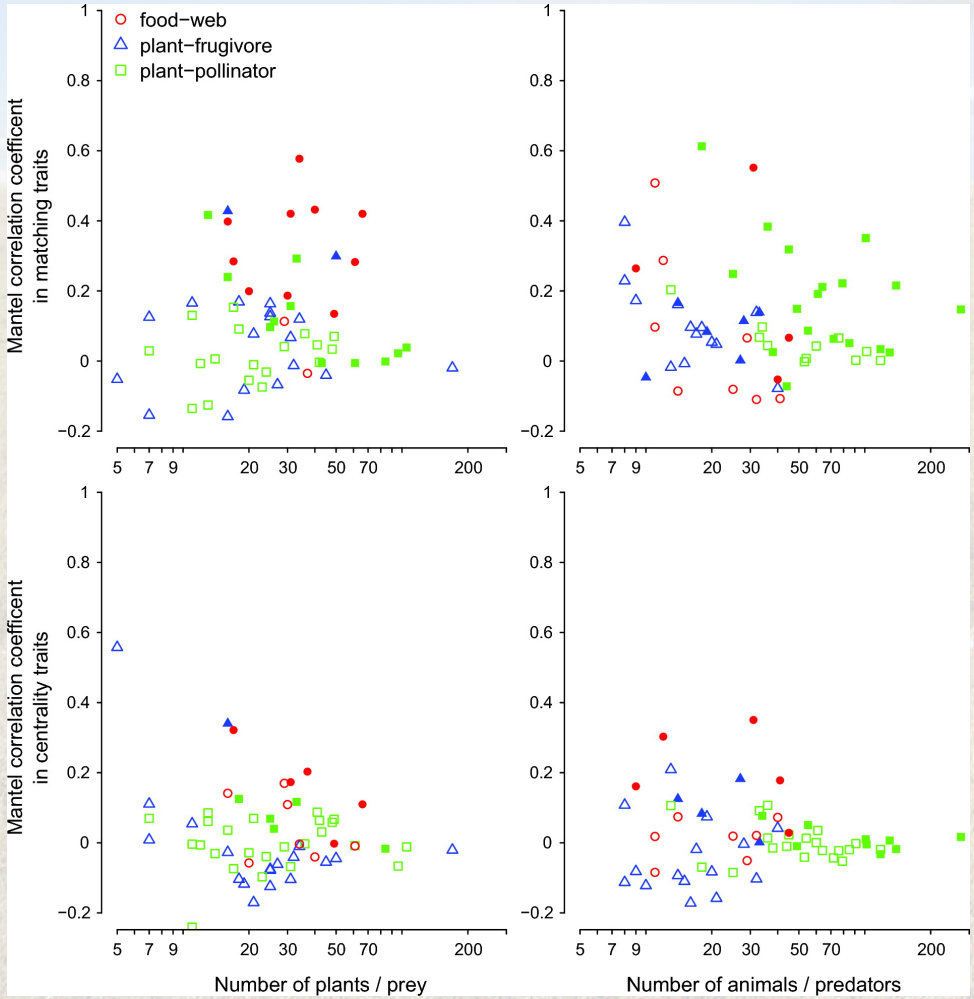
Why?

It's hard to fit a Web on a Tree because of all the fine wirings.

Courtesy of Erik Moncada

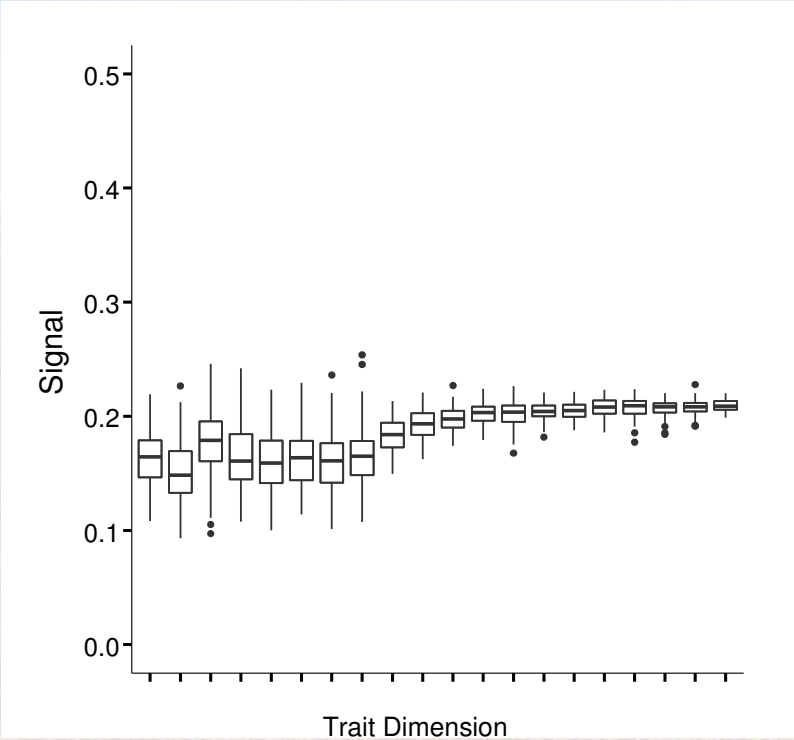
Why?

And you don't always get something out of it.

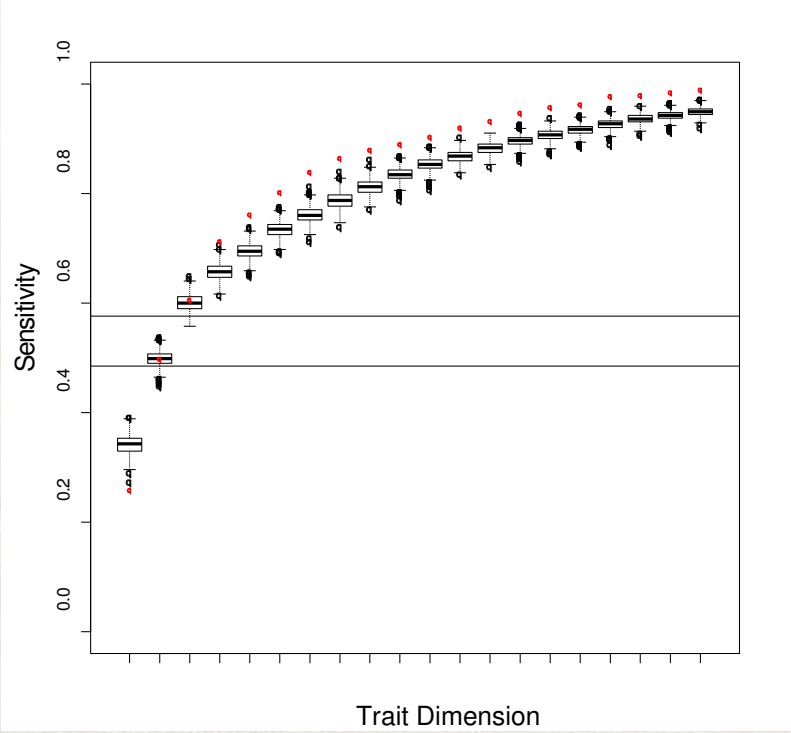


Rohr & Bascompte, Am Nat 184, 5 (2014)

What?



Phylogenetic signal



Model sensitivity

The food web's backbones web exhibits Evolutionary signal.

[1] From gvdr & Stouffer, in press

Food Webs embedded

- From $G = (V, E)$ to a metric space and back via Random Dot Product Graph

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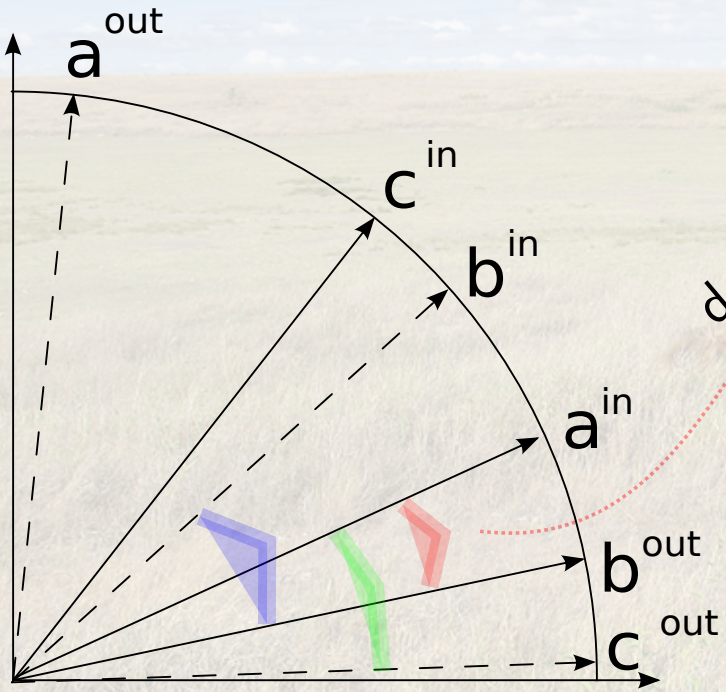
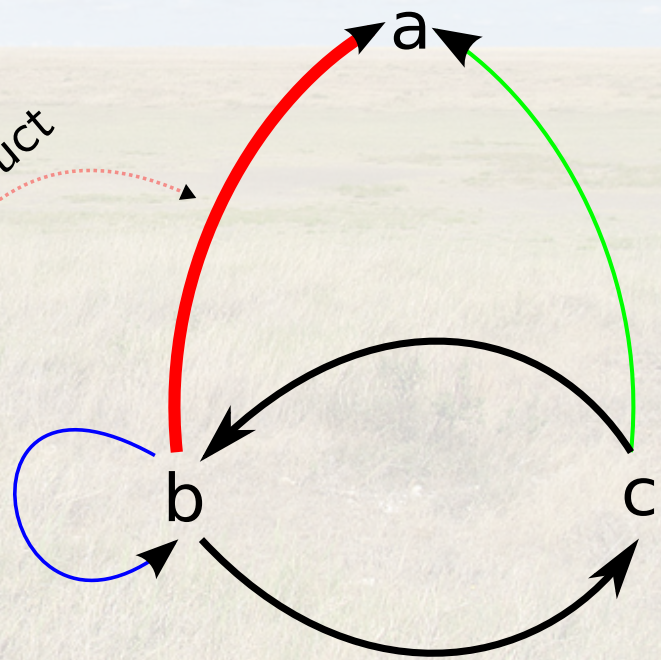
- SVD(Adjacency) gives $\mathbb{T}_{out}$ and $\mathbb{T}_{in}$

Food Webs embedded



dot product



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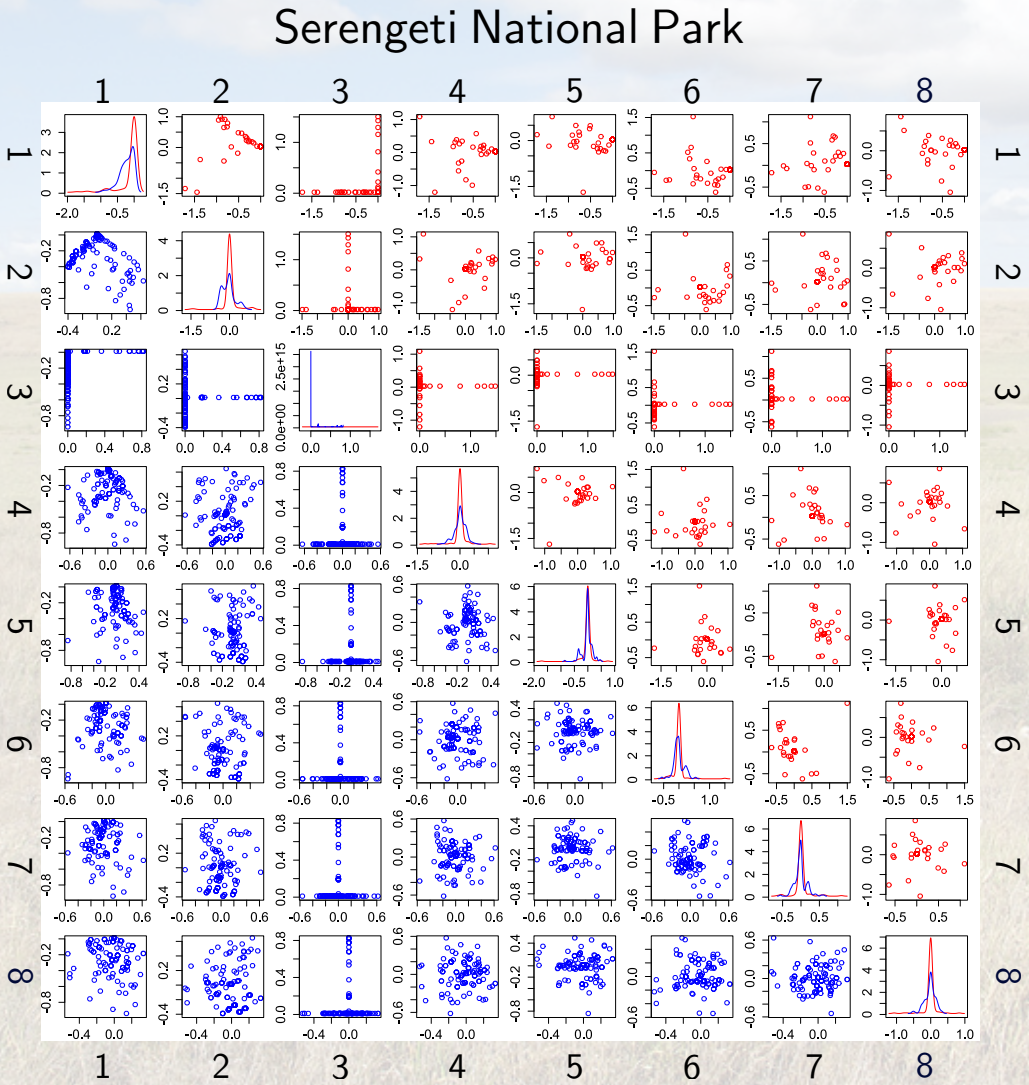
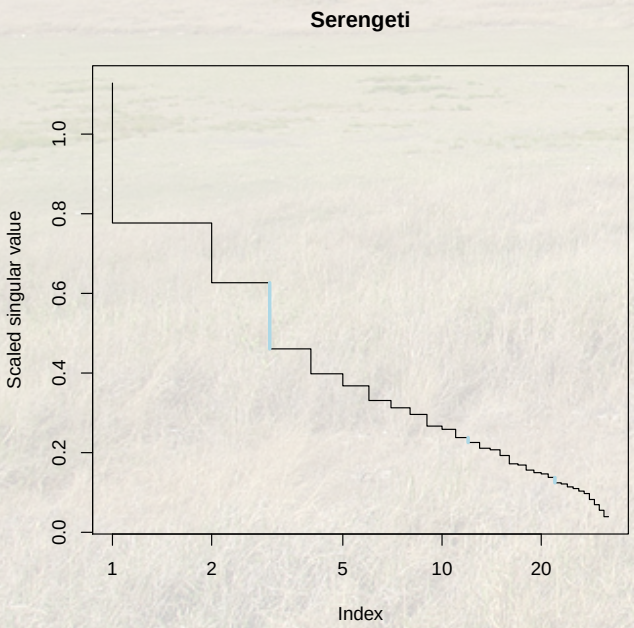
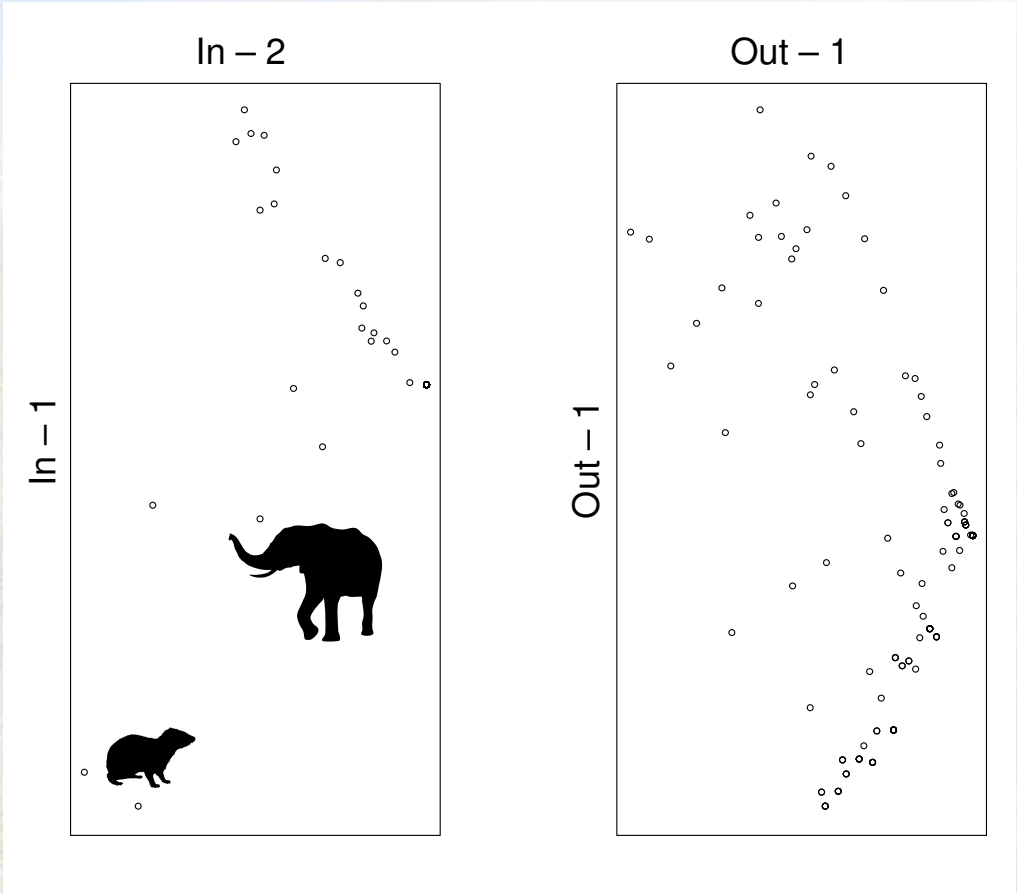


A Food Web as you've never seen it. And don't want to see again.

Food Webs embedded





We can choose dimensionality based on singular values.

PCM crash course

Expected vs. Observed trait distribution

$$\text{vcv}\left(\mathbb{T}|\tau, \text{null model}\right) \text{ vs. } \text{vcv}\left(\mathbb{T}\right)$$

PCM crash course

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PCM crash course

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  eventually $\sigma = \sigma(i,t)$, e.g., $\sigma(t) = \sigma_0 e^{rt}$.
- Ornstein-Uhlenbeck (BM + rubber band):

$$\mathrm{d}\mathbb{T}(i,t) = \alpha\left(\Theta - \mathbb{T}(i,t)\right)\mathrm{d}t + \sigma \mathrm{d}B(t)$$

  eventually $\alpha = \alpha(i,t)$ and/or $\Theta = \Theta(i,t)$, "branch colouring".

More questions (than answers)

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  p-values told me...

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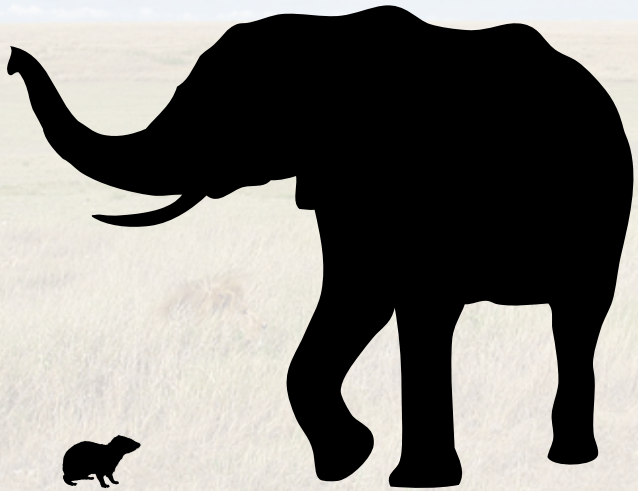
  $d \in \{2, \ldots, 8\}$
- $\therefore$ "fine wirings" may be deceiving
- Evolutionary model is (a bit) inadequate

  no interaction effects

(Not a) Conclusion

- Evolutionary distinctiveness vs. Web Centrality
  Do evolutionary unique species play a keystone role in Food Webs?



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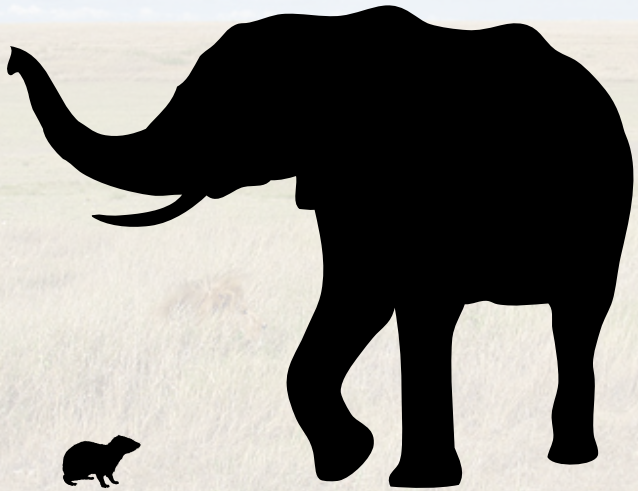

- An ecological informed model of species evolution it's (almost) there.
  Consider an Ornstein and Uhlenbeck process and ask:
  What if $\Theta = \Theta(i, T(t))$ depends on the traits distribution?

Thanks!

Joint work with Daniel B. Stouffer (University of Canterbury)

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By the way, I'm currently looking for a postdoc position.
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