Evolving in a tangled world

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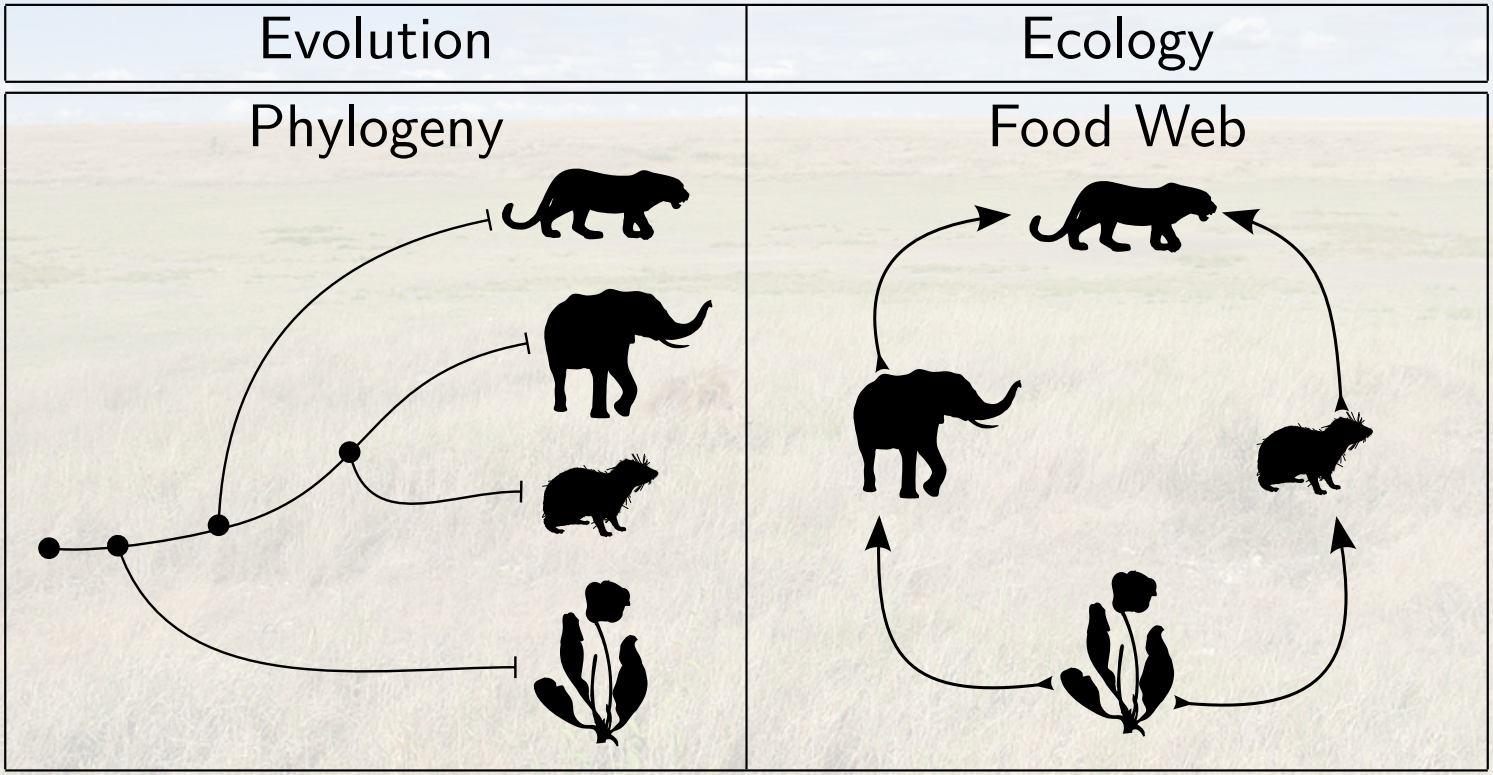
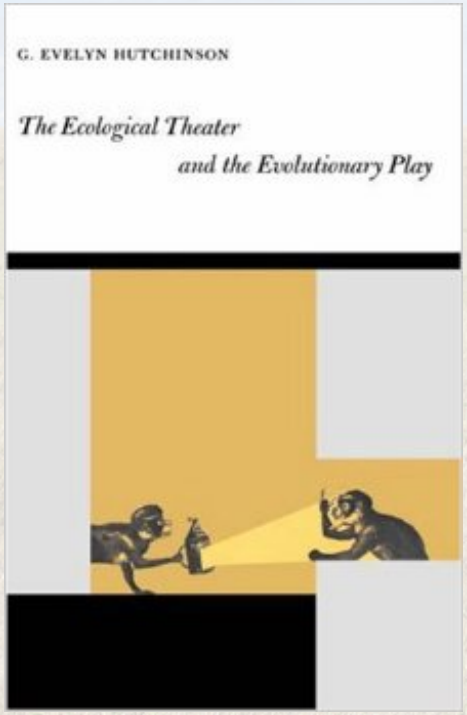
Species are entangled



the Theater and the Play



Ecology and Evolution occur on different time scales?

the Theater and the Play

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*

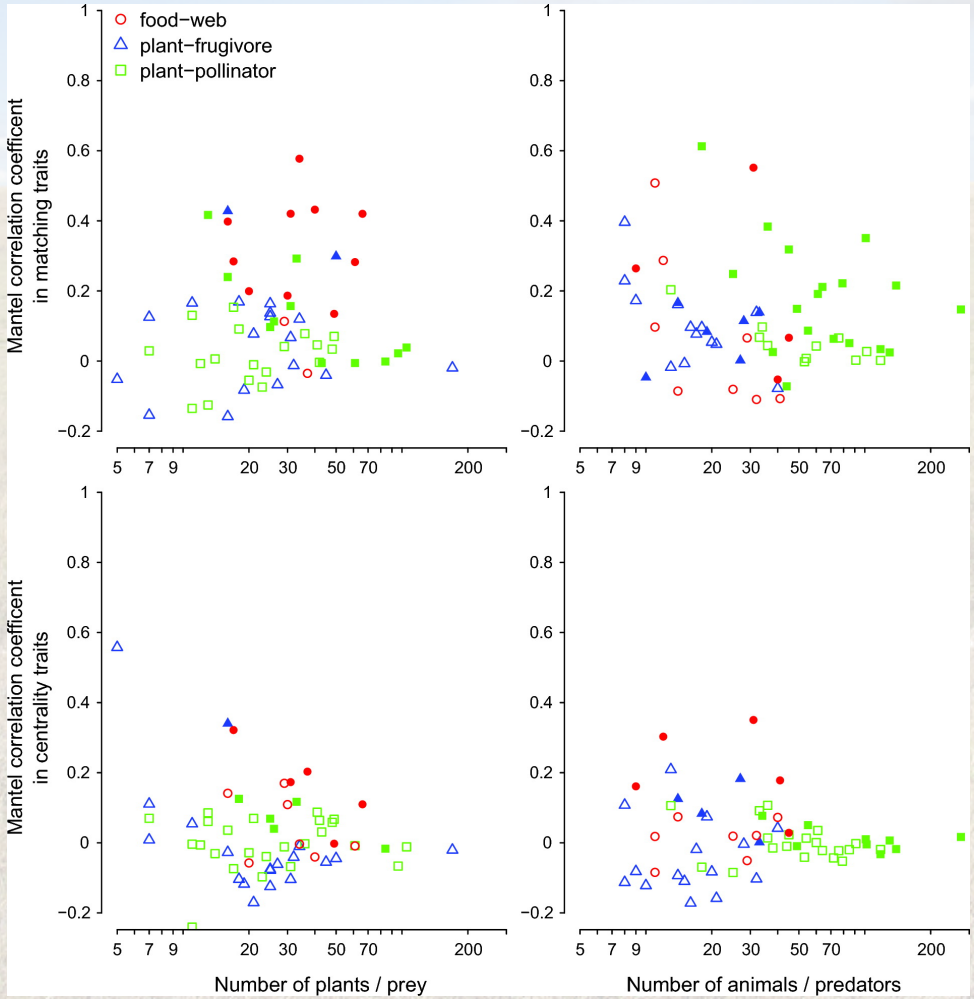
A Web on a Tree

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

Courtesy of Erik Moncada

A Web on a Tree

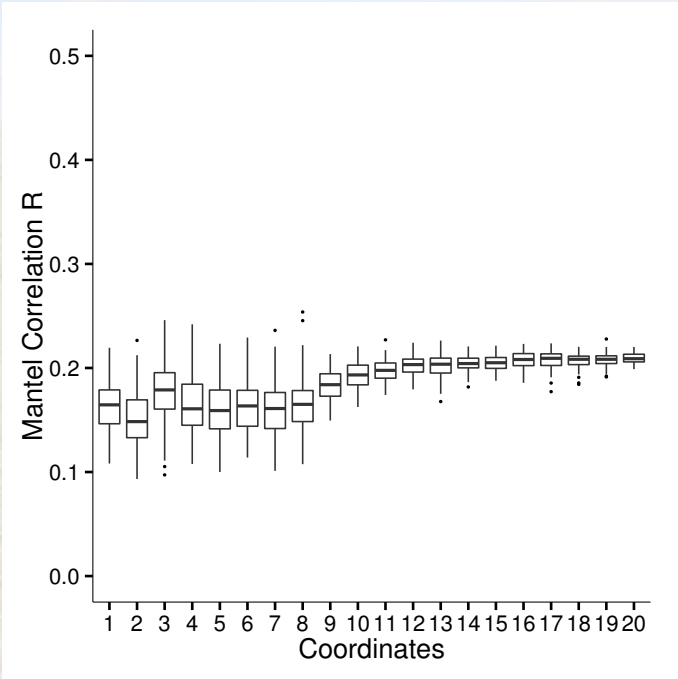
And you don't always get something out of it.



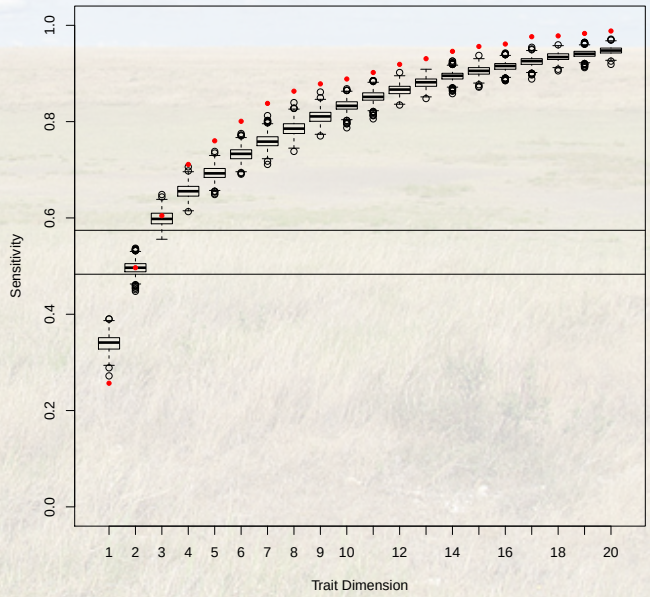
Rohr & Bascompte, Am Nat 184, 5 (2014)

A Metric Space on a Tree

What if we could do without the wiring?



Phylogenetic signal



Model sensitivity

The stochastic backbones of Food Webs exhibit an Evolutionary signal.

Food Webs embedded

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

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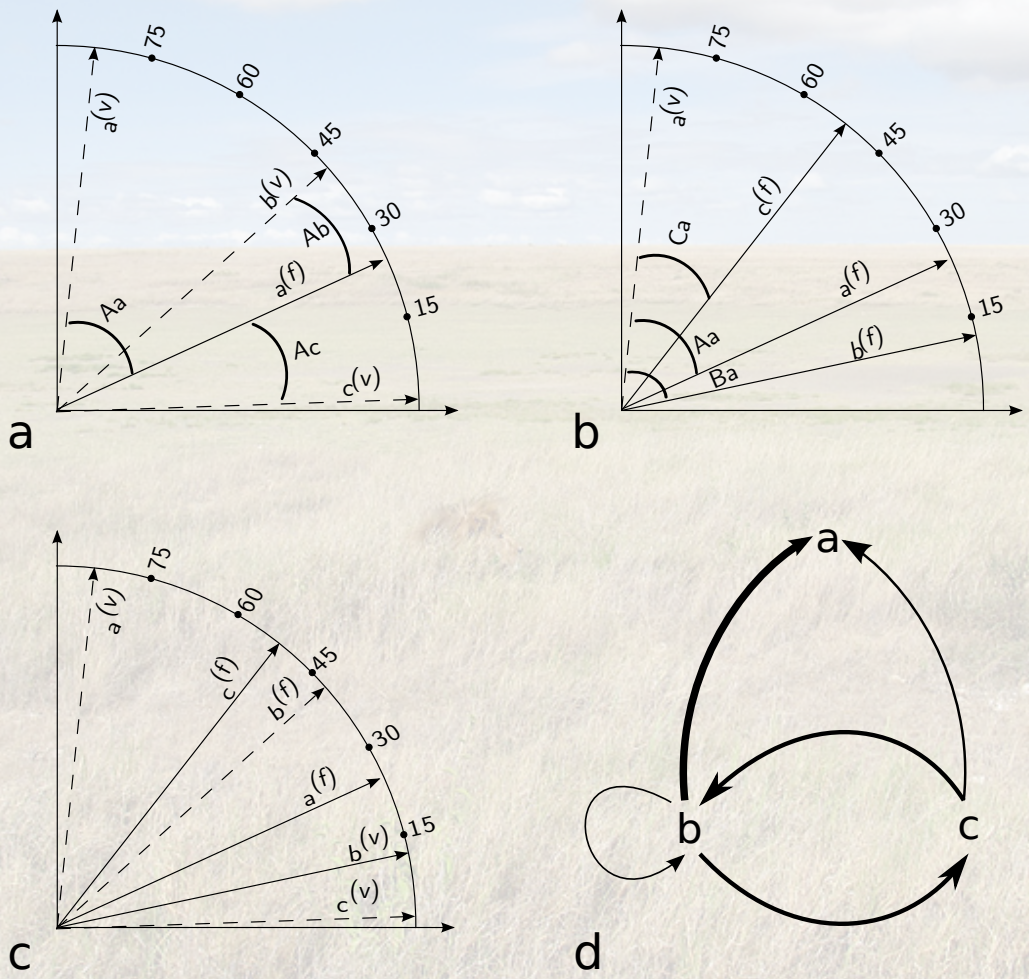
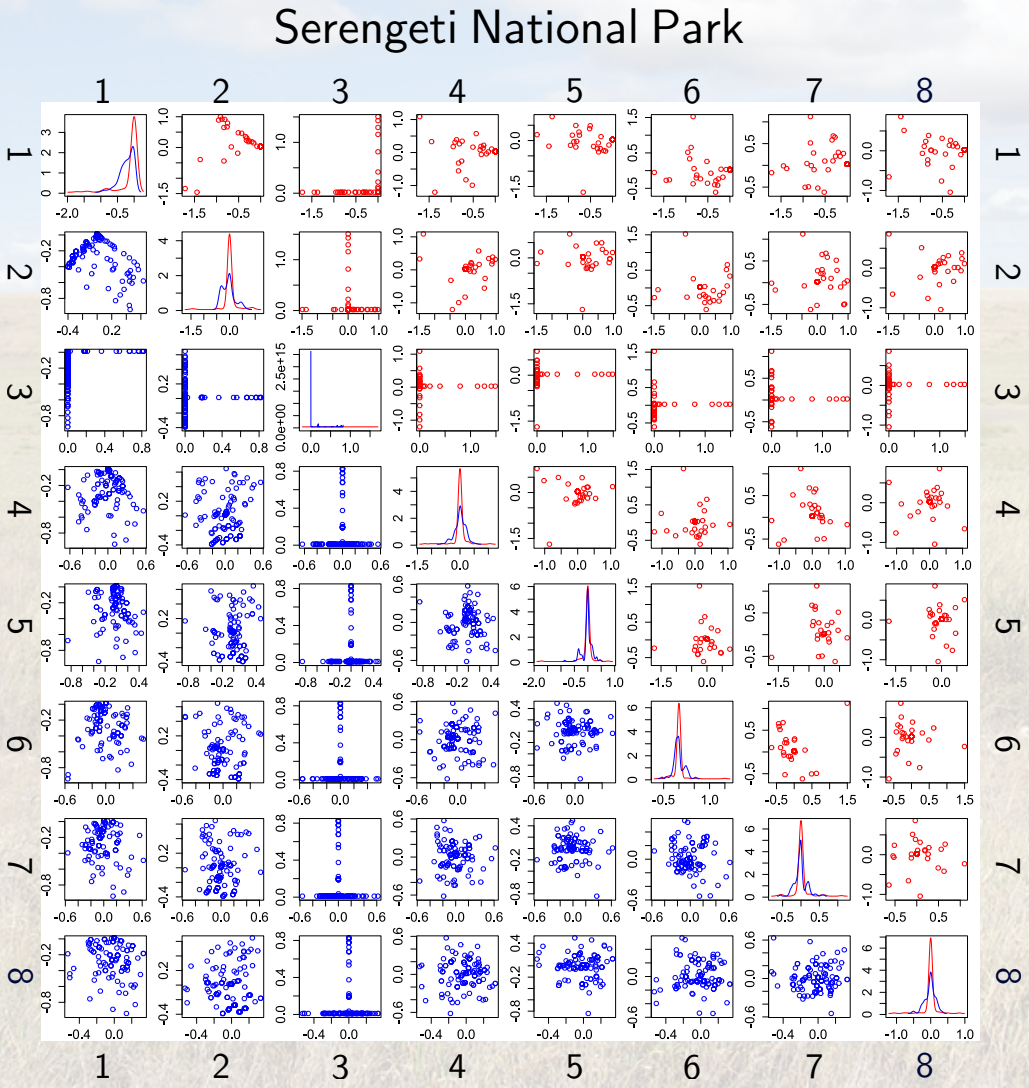
- $\mathbb{P}(i \to j) = \mathbb{T}_{out}(i) \cdot \mathbb{T}_{in}(j)$
- SVD(Adjacency) gives $\mathbb{T}_{out}$ and $\mathbb{T}_{in}$

Food Webs embedded



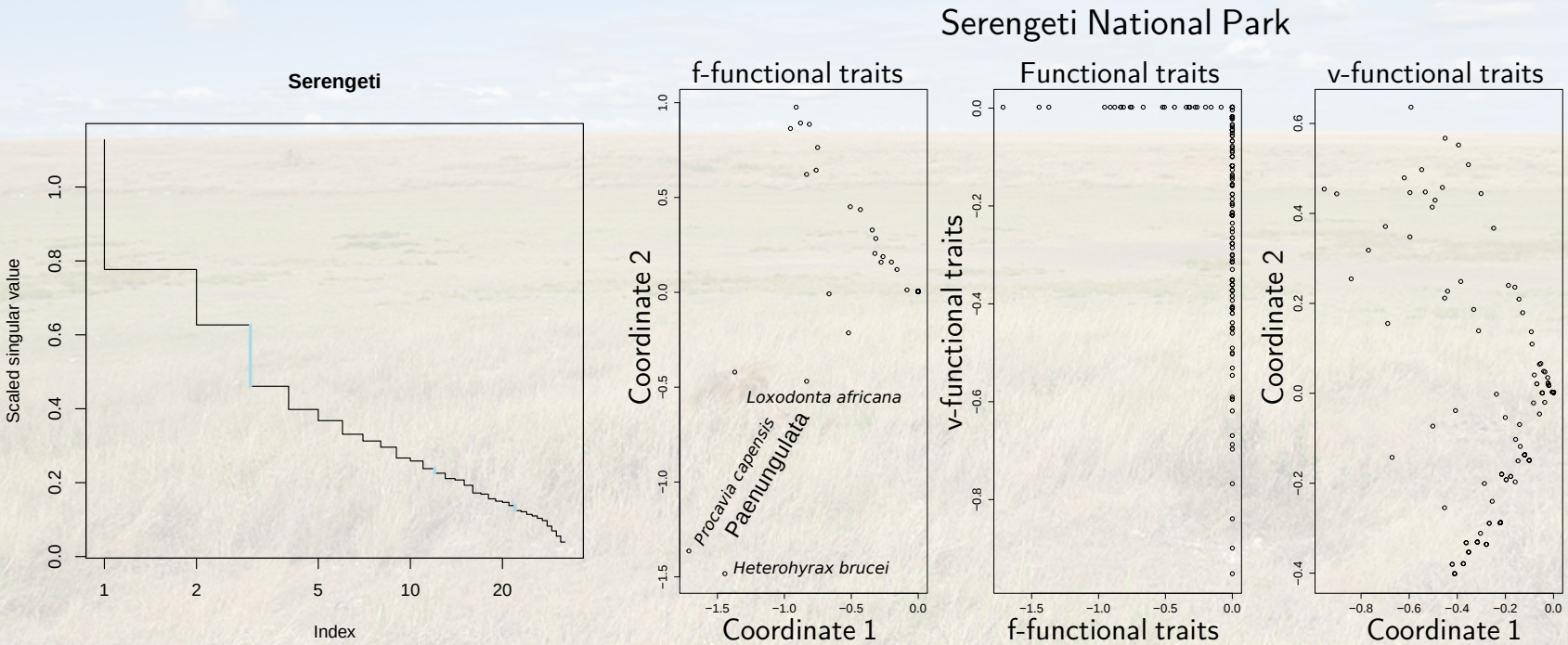
Three species toy model. gvdr & Daniel B. Stouffer, appearing

Food Webs embedded



A Food Web as you've never seen it

Food Webs embedded



SVDS allows helps in choosing a suitable model dimension.

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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$$\mathrm{d}\mathbb{T}(i,t) = \sigma \mathrm{d}B(t)$$

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PCM crash course

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- 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 anybody?

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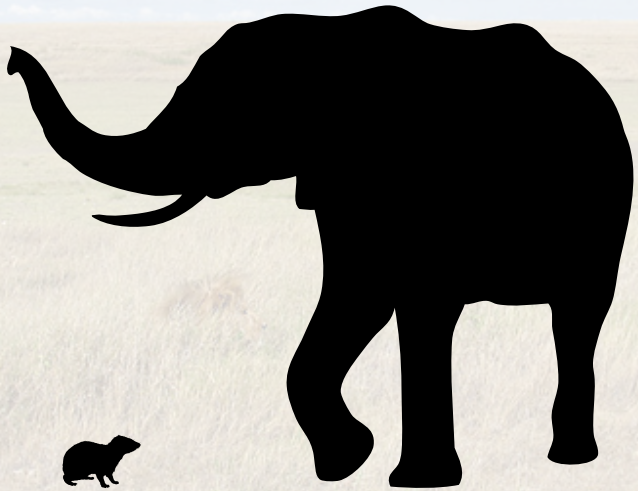
  $d \in \{2, \ldots, 8\}$
- $\therefore$ "fine wirings" may be deceiving
- Evolutionary model is inadequate

  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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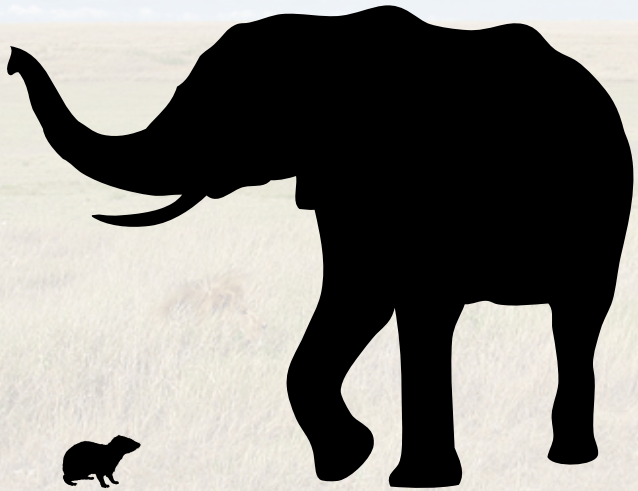

- An ecological informed model of species evolution maybe it's (almost) there.
  I am looking at you, Ornstein and Uhlenbeck:
  What if $\Theta = \Theta(i, T(t))$?

Thanks!

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

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