Since last meeting

Current projects

- Brachiopods
- Mammals

Timeline

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- Evolution 2015 talk
- GSA 2015 talk
- Chapter 1 published (PNAS)
  - Effects of biotic traits on mammal species duration
- Chapter 2 submitted (Evolution)
  - Interplay between extinction intensity and selectivity in brachiopod extinction
  - Submitted early October, still in review?
- Did not submit DDIG

Review possible chapter 1

Review possible chapter 2

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Timeline

Regional patterns in the diversification of Paleozoic brachiopods

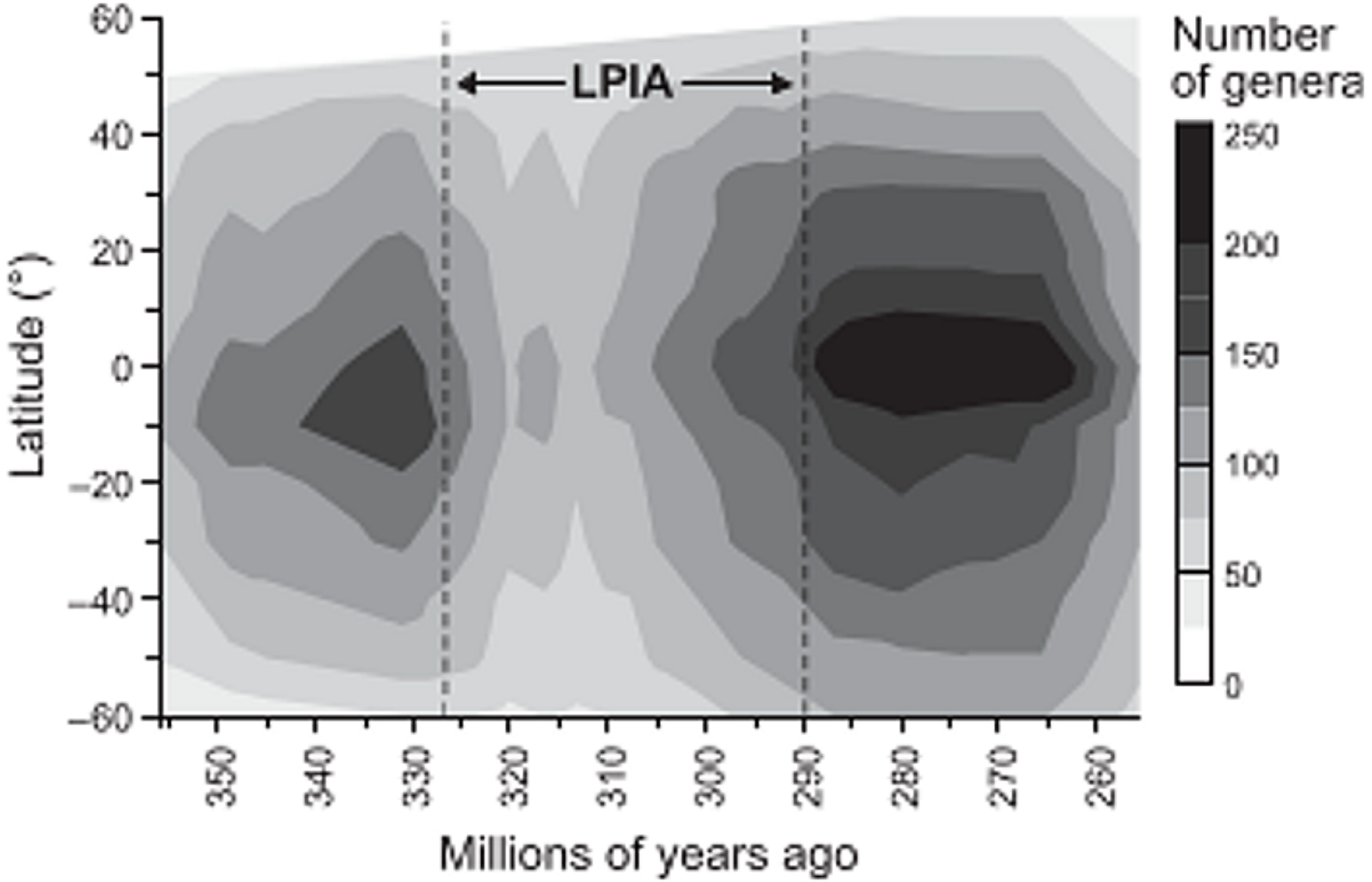
Question

How does differential taxonomic entrance and loss contribute to regional (e.g. latitudinal) diversity?

Motivation

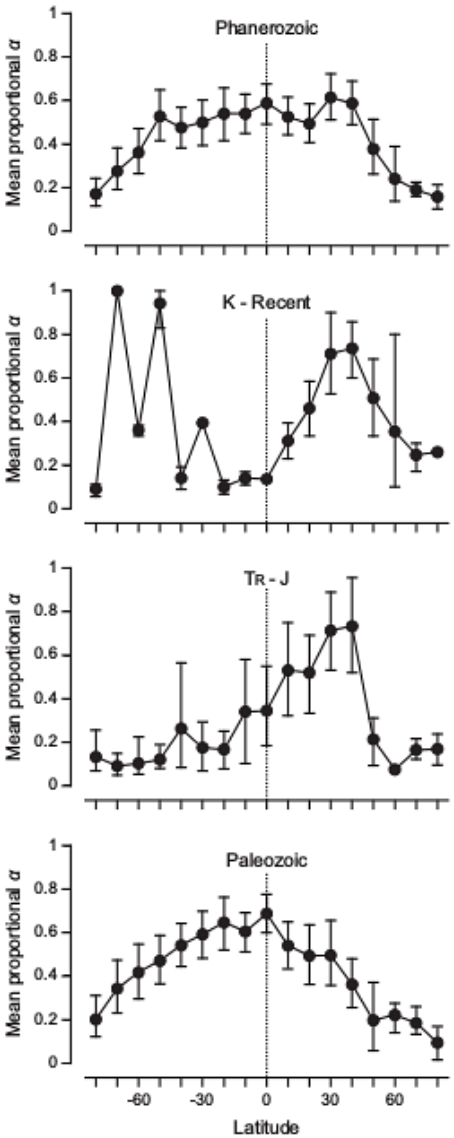
- latitudinal diversity gradients
  - through lense of a diversification process
- regional as opposed to global
  - variation within regions may not match global pattern (more biologically relevant?)
  - partial follow up to brachiopod survival work

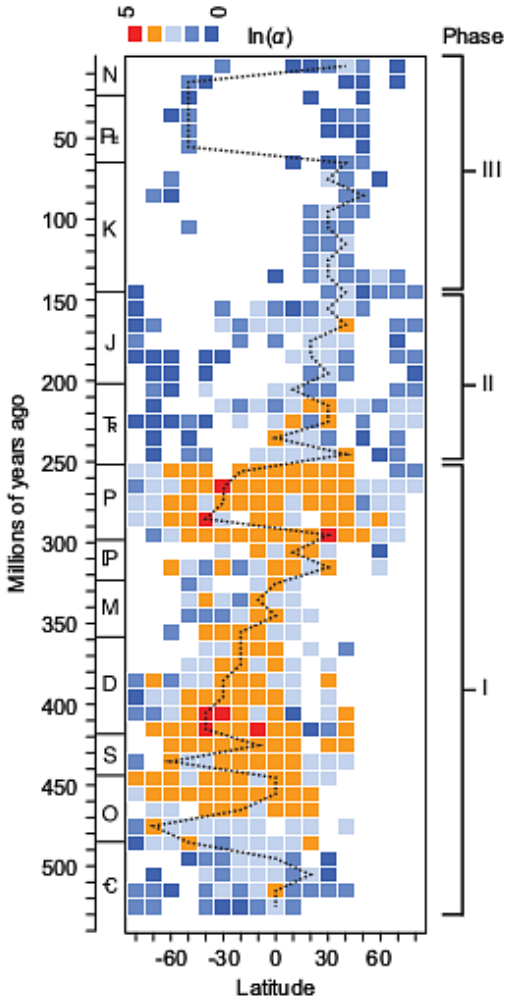
Brachiopod latitudinal diversity



(Powell 2007 *G. Eco. Biogeo.*)

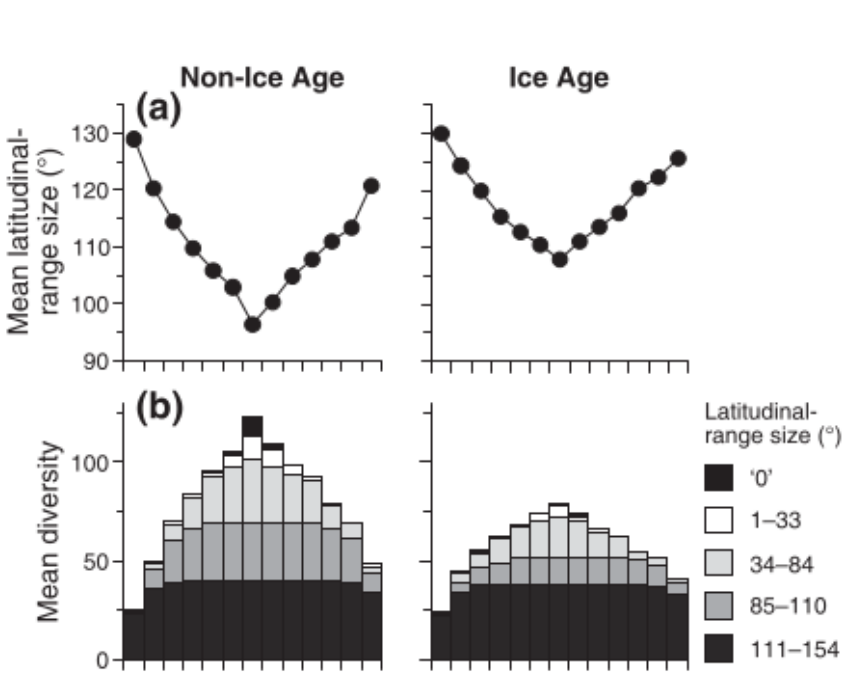
Variation in bioversity gradient

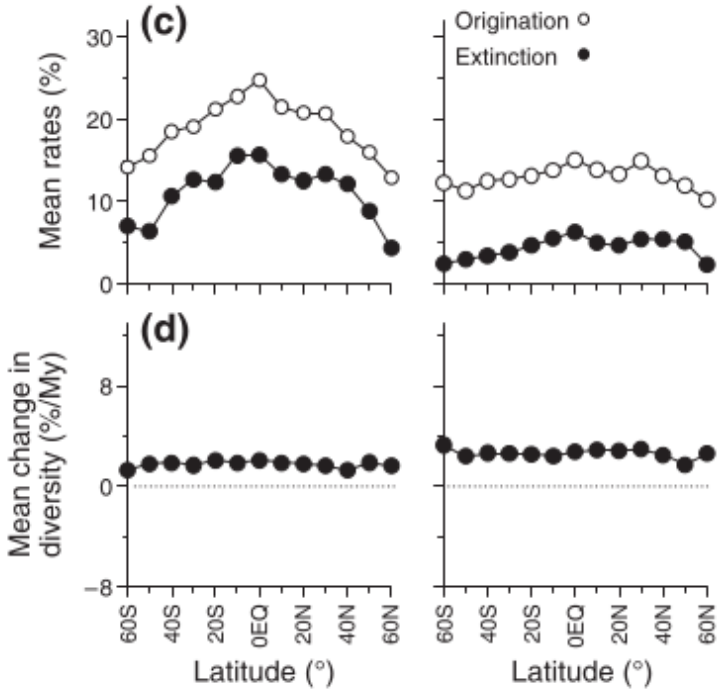




(Powell *et al* 2015 *Paleobio.*)

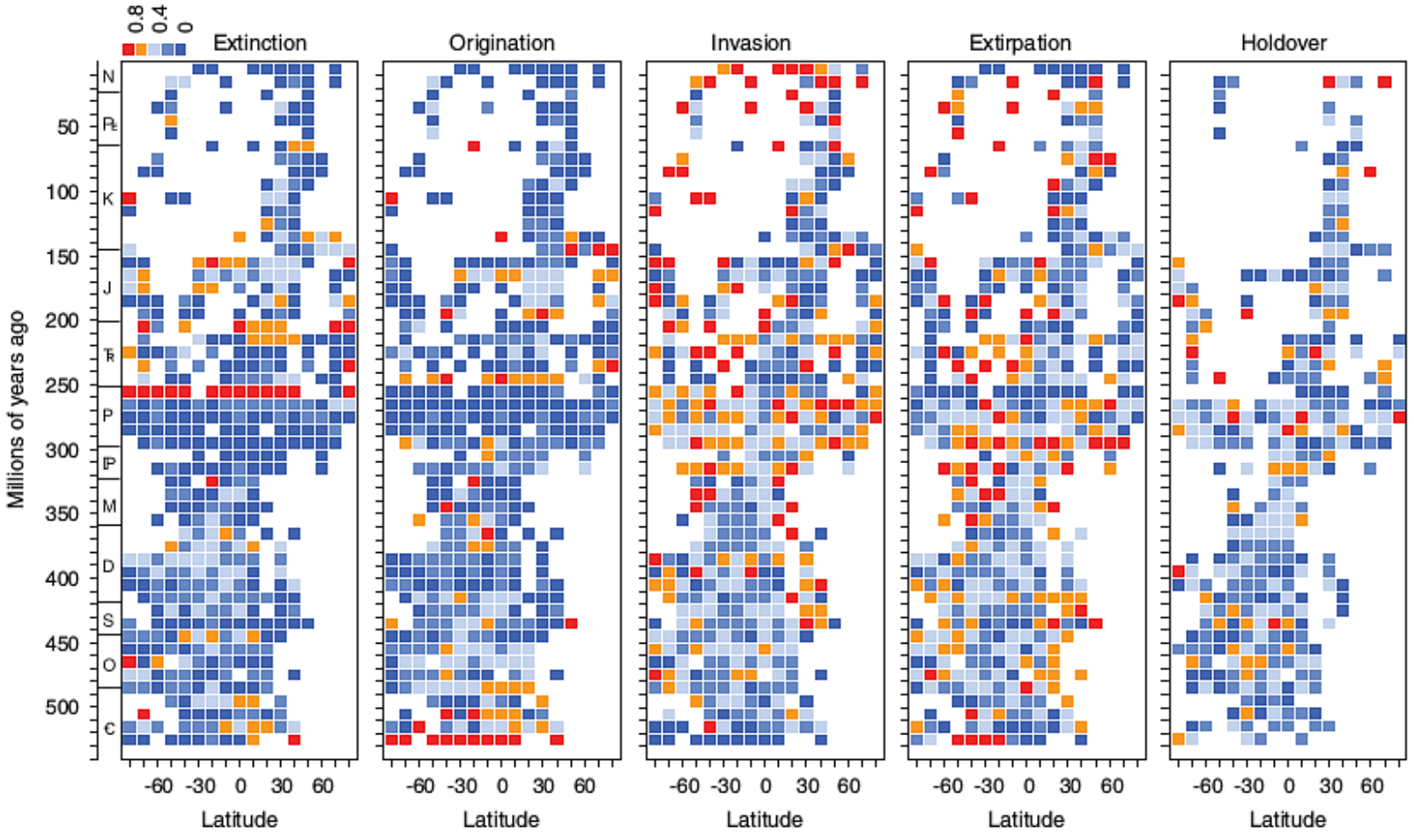
“Modes” of latitudinal diversity





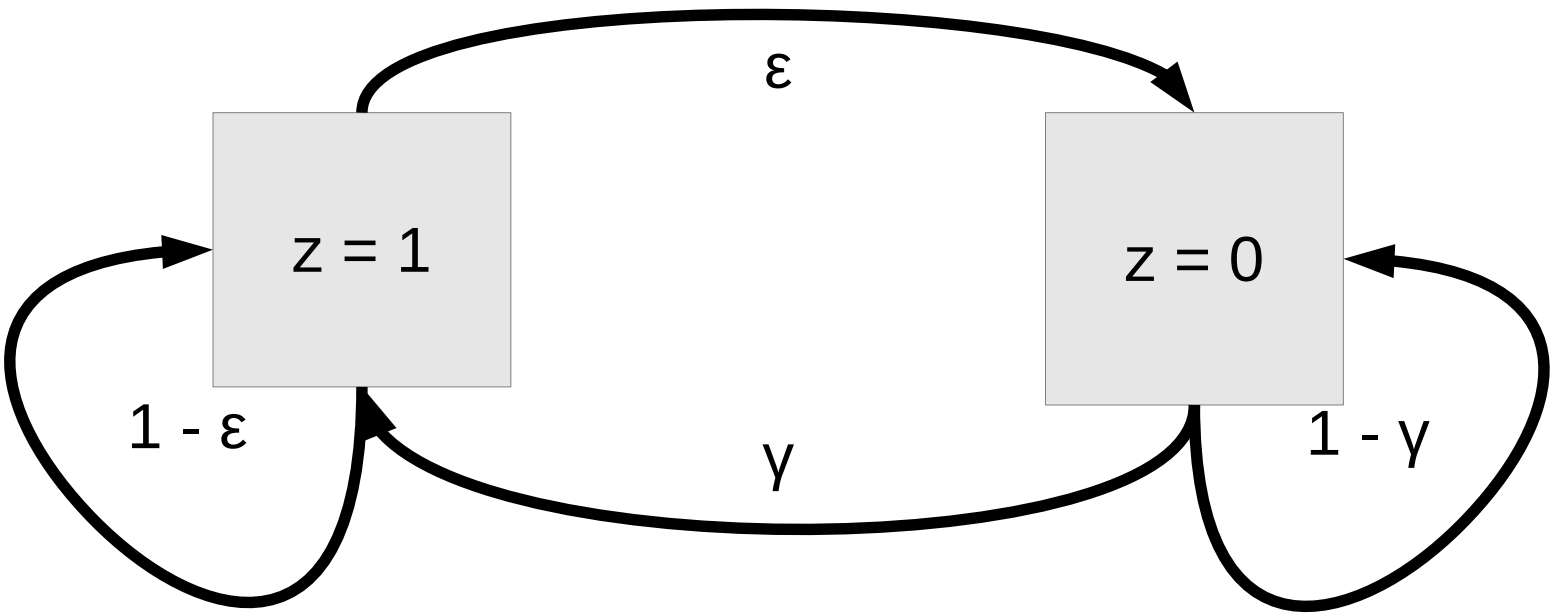
(Powell 2007 *G. Eco. Biogeo.*)

Change in evenness + diversity

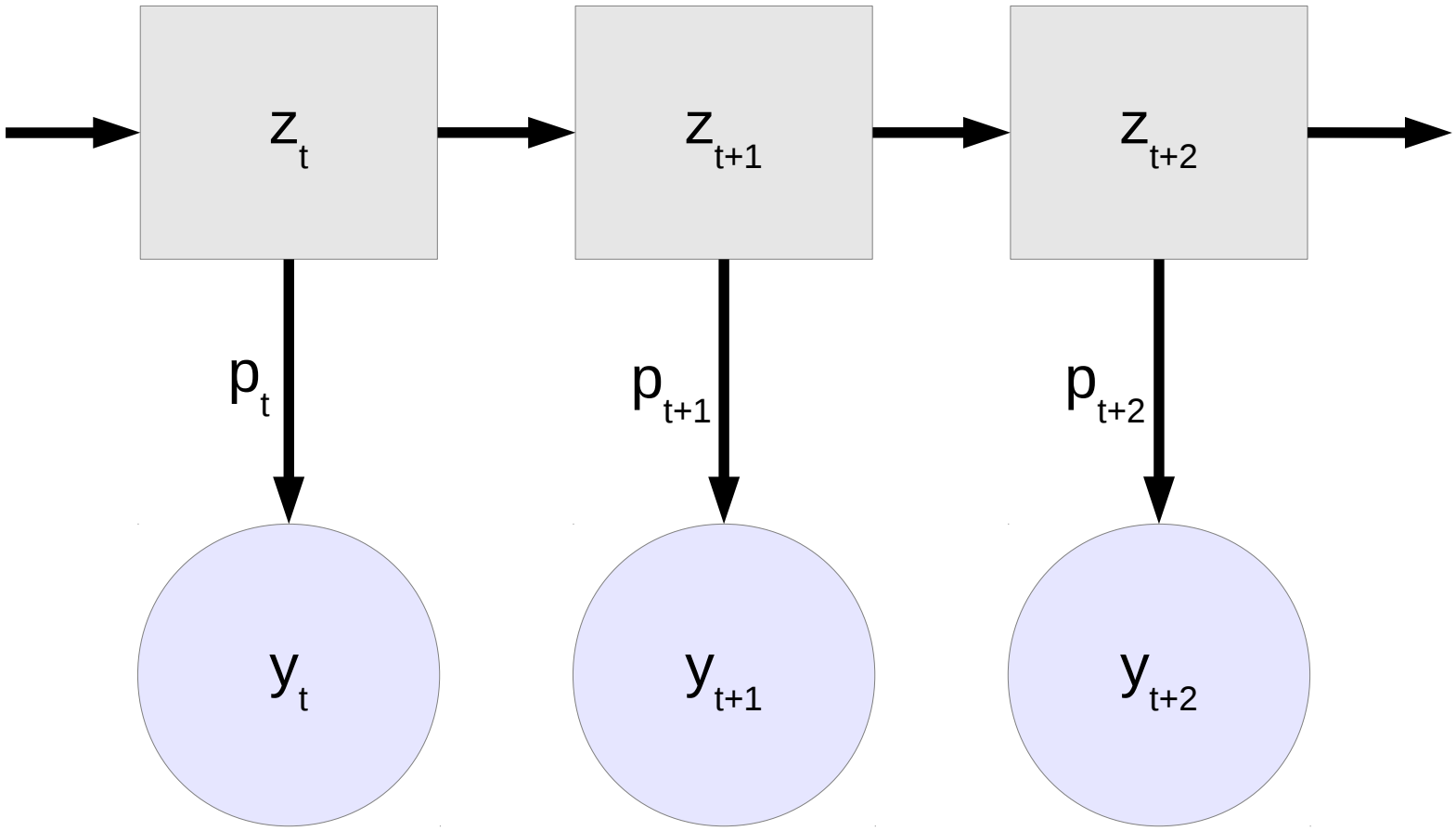


(Powell *et al* 2015 *Paleobio.*)

Model structure: Markov model



Model structure: hidden state



Preliminary results

Major assumptions

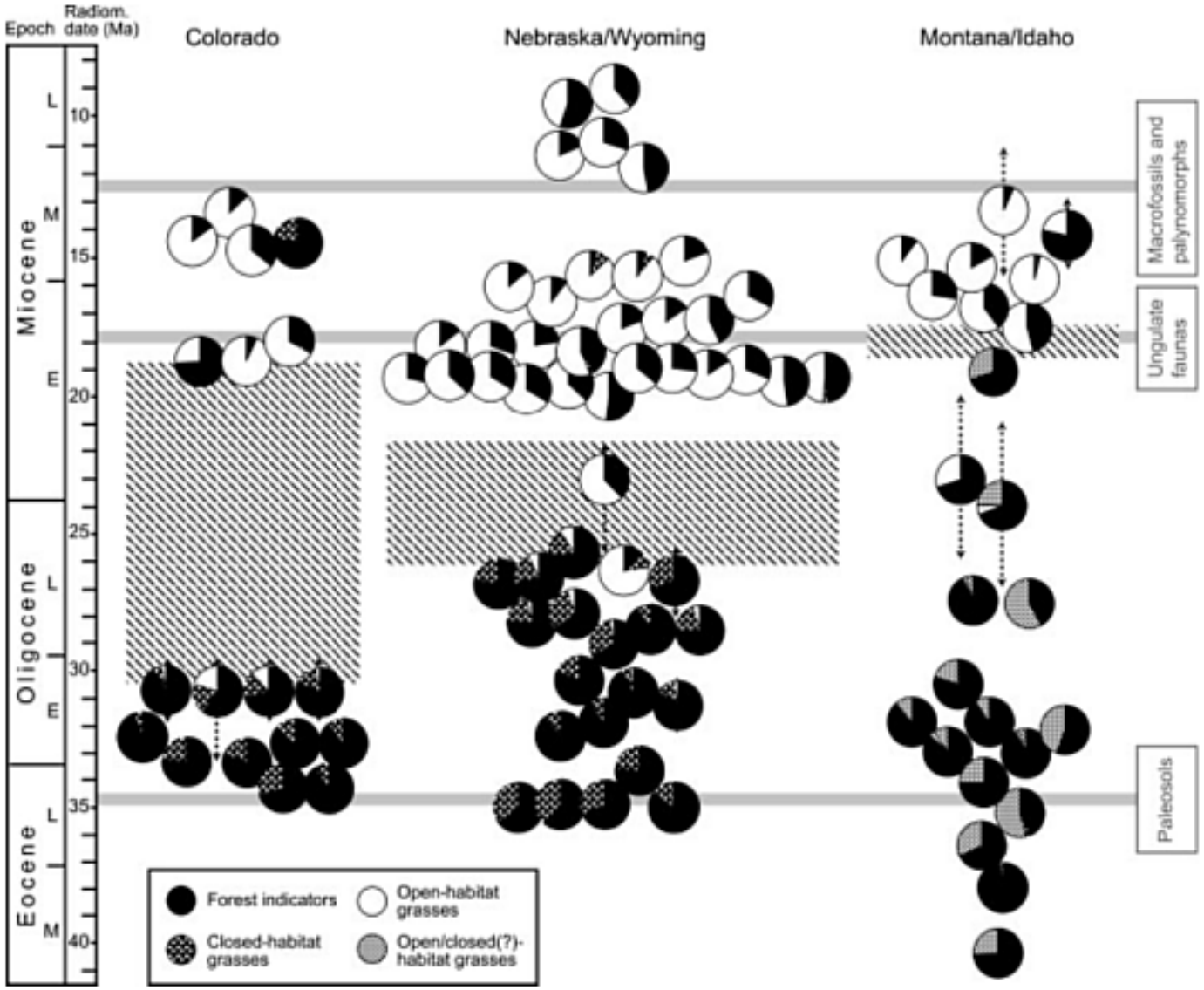
- model is only a first-order Markov process
  - can lead to some taxa existing longer than in actuality
- any taxon can occur in any geographic unit independent of other units
- both possibly controlled for by sampling rate through time
  - further assumes all times and places can be considered similar
- relaxing all of these assumption increases complexity
  - expand to whole Phanerozoic and/or other taxonomic groups?

Changes in Cenozoic mammal ecotype composition

Question

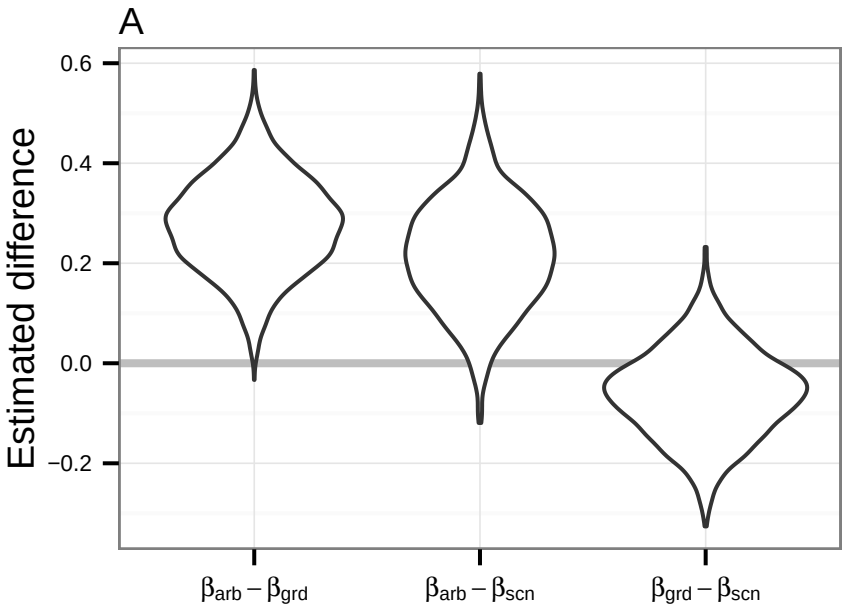
How do occurrence ratios of mammalian ecotypes change over time?

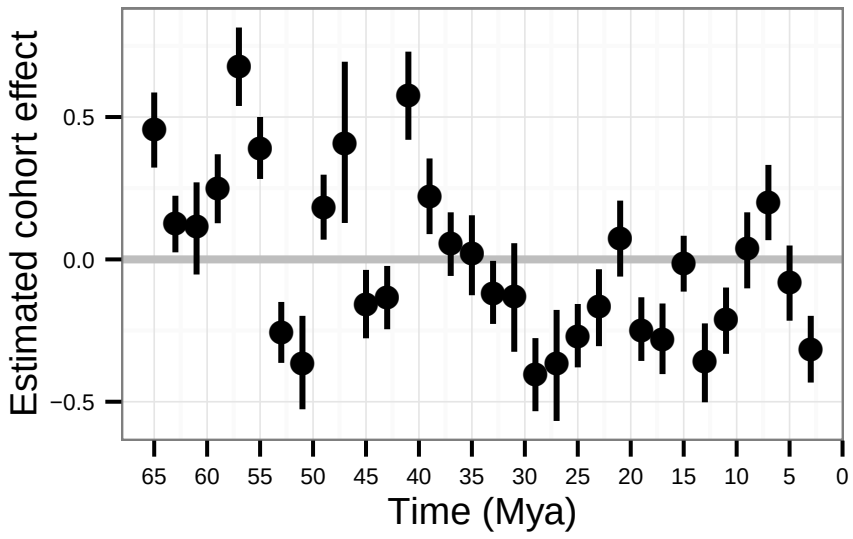
Environmental shift



(Stromberg 2005 *PNAS*)

Possible link?





(Smits 2015 *PNAS*)

Multi-logit regression

$$
\begin{aligned}
y_i &\sim \text{Categorical}(K, \pi) \\
\pi_k &= \frac{\exp(\beta_{k,j[i]} X_i + \lambda_k)}{\sum_{k=1}^{K} \exp(\beta_{k,j[i]} X_i + \lambda_{k,i})} \\
&\text{where } \beta_{K,j[i]} X_i + \lambda_{K,i} = 0 \\
\lambda_k &\sim \text{MVN}(0, \tau_k^2 \Sigma) \\
\beta_{k,j} &\sim \mathcal{N}(\beta'_k, \sigma_k)
\end{aligned}
$$

Preliminary results

Further developments

- NOTE currently single flat mean; allow trend/multiple?
  - time order is not currently modeled
- NOTE no phylogenetic effect for $k = K$
  - every thing is relative to it
- increased categorization (e.g. frugivory), covariates (e.g. climate)?
- observed taxa represent a proportional sample of reality
  - how can this be overcome in a model based framework?
- limits to complexity of model due to sample size

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Things to consider

- TAing this spring and next year
- Funding?
  - FMNH fellow (but I don't spend time at the museum).
- Estimates for time of completion?
- Post-doctoral opportunities?