

Since last meeting

Current projects

Brachiopods

Mammals

Timeline

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Since last meeting

- ▶ 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 of possible chapter 1

- ▶ Published in PNAS
- ▶ I took all of your comments very seriously and they really improved the paper.
 - ▶ Rick for forcing on the phylo (didn't do figure, but made me use it).
 - ▶ Ken and David for pushing about modern extinction risk.
 - ▶ Michael and Ken for helping me write it in english.
- ▶ Sorry I didn't send it to anyone except Michael and Ken.

Review of possible chapter 2

- ▶ Submitted to Evolution
- ▶ What my patterns of extinction in Australia project eventually turned into.
 - ▶ Sorry about that.
 - ▶ Primarily drive by sample size issues.
- ▶ Sorry I didn't send it to anyone except michael and ken before submitting it.
 - ▶ This is actually a really good time to get all of your comments!

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Regional patterns in the diversification of Paleozoic brachiopods

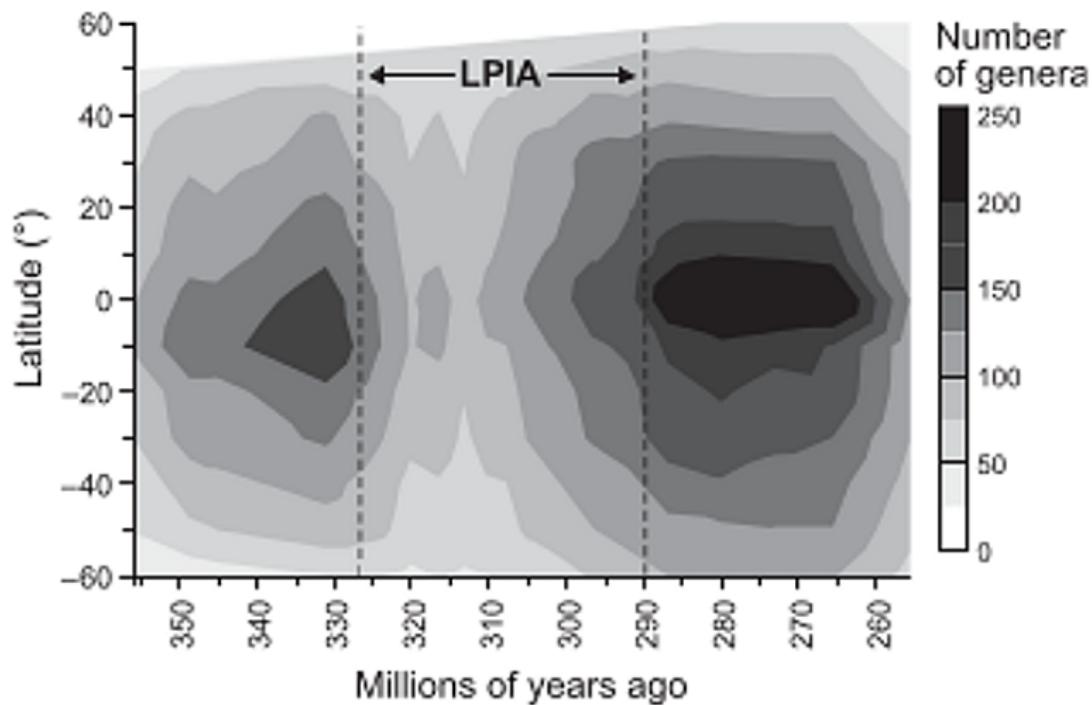
Question

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

Motivation

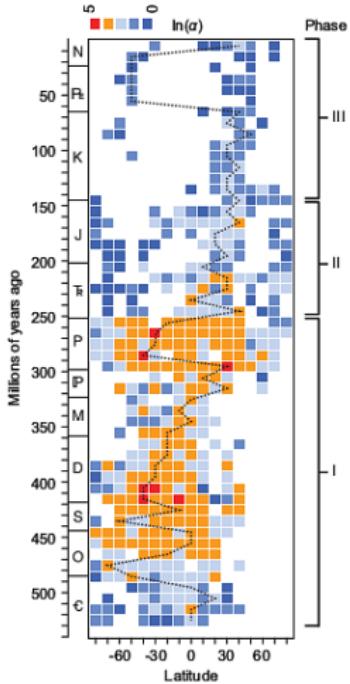
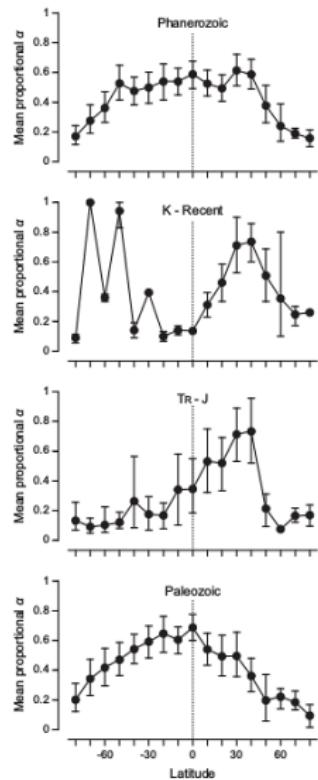
- ▶ latitudinal diversity gradients
 - ▶ through lense of a diversification process
- ▶ regional as opposed to global
 - ▶ variation within regions may not match global pattern
(more biologically relevant?)
 - ▶ partial follow up to brachiopod survival work

Brachiopod latitudinal diversity



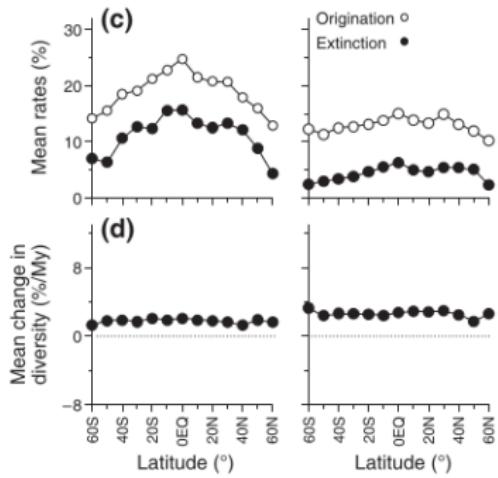
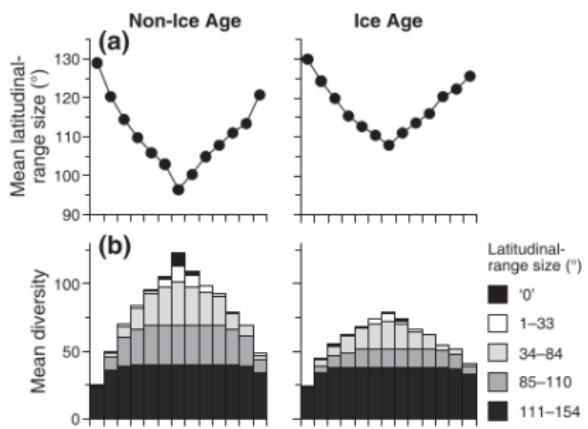
(Powell 2007 *G. Eco. Biogeo.*)

Variation in bioversity gradient



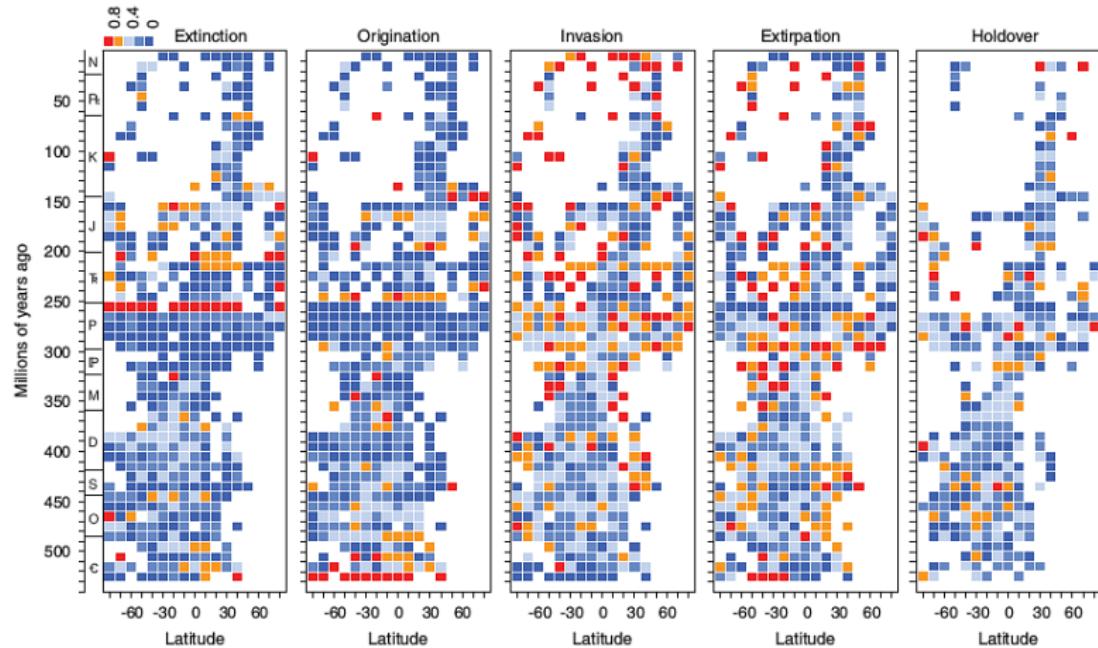
(Powell *et al* 2015 *Paleobio.*)

“Modes” of latitudinal diversity



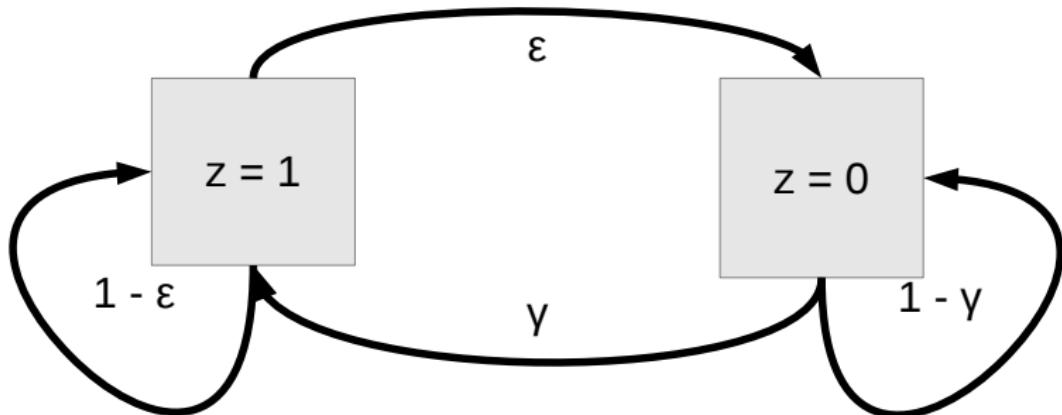
(Powell 2007 *G. Eco. Biogeo.*)

Change in evenness + diversity

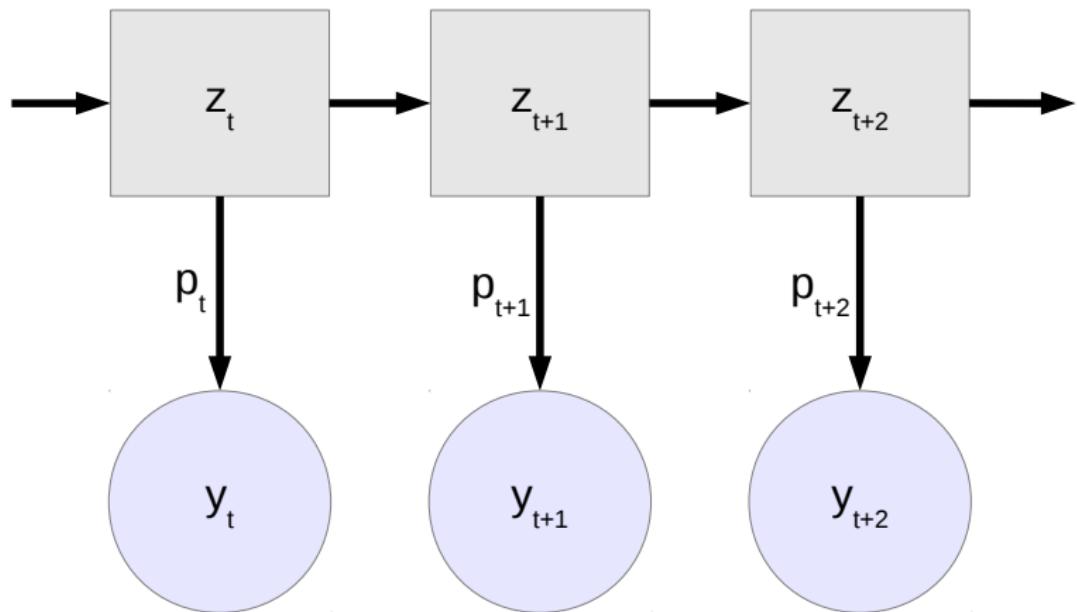


(Powell *et al* 2015 *Paleobio.*)

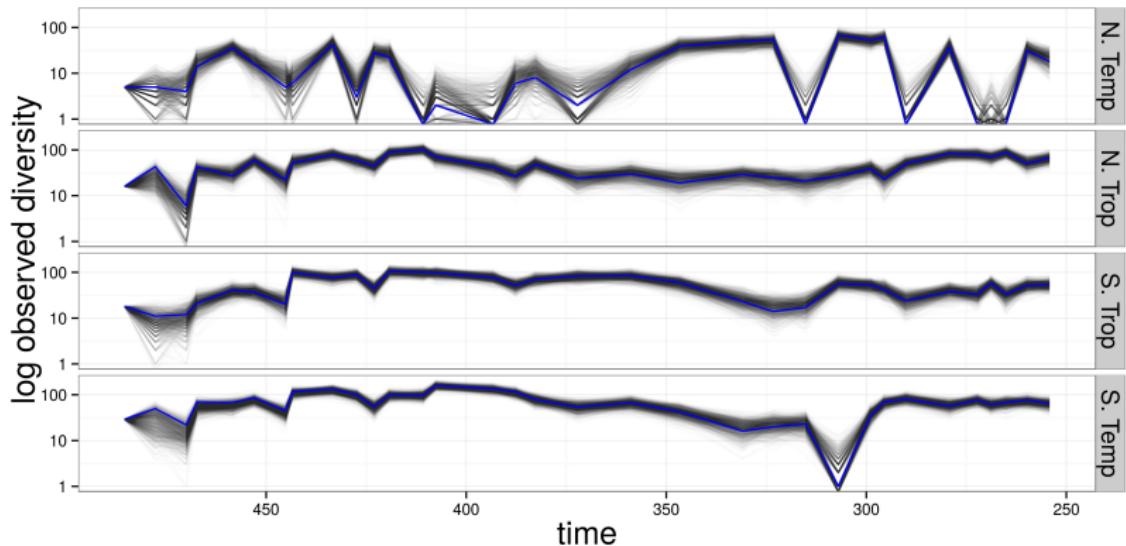
Model structure: Markov model



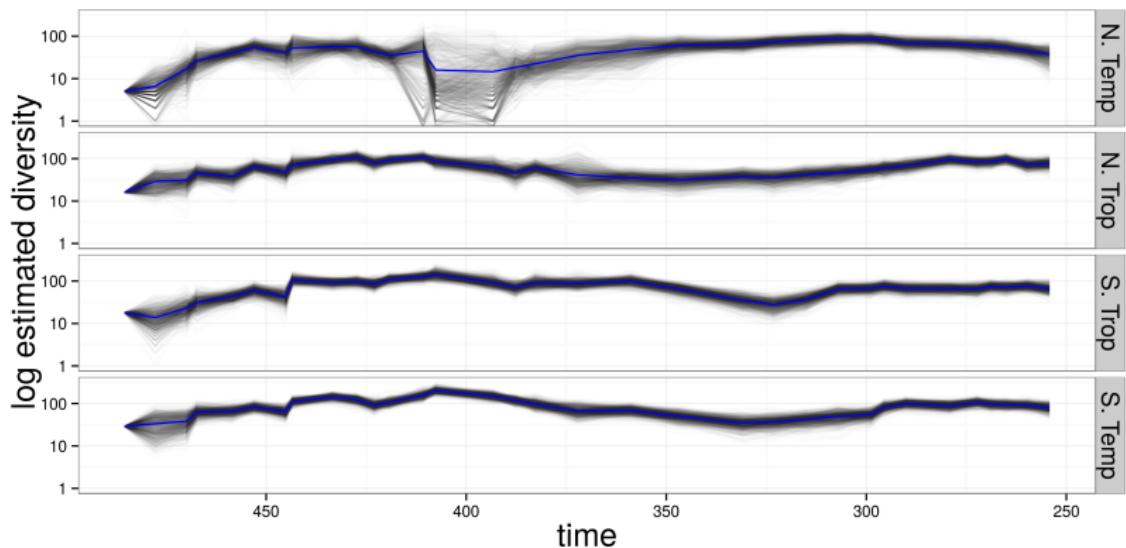
Model structure: hidden state



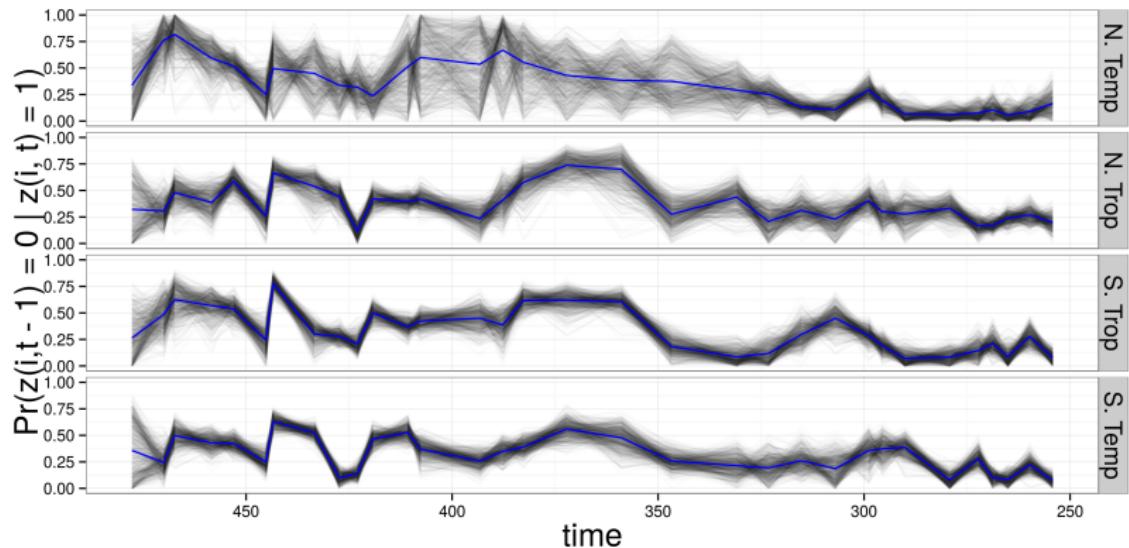
Observed diversity



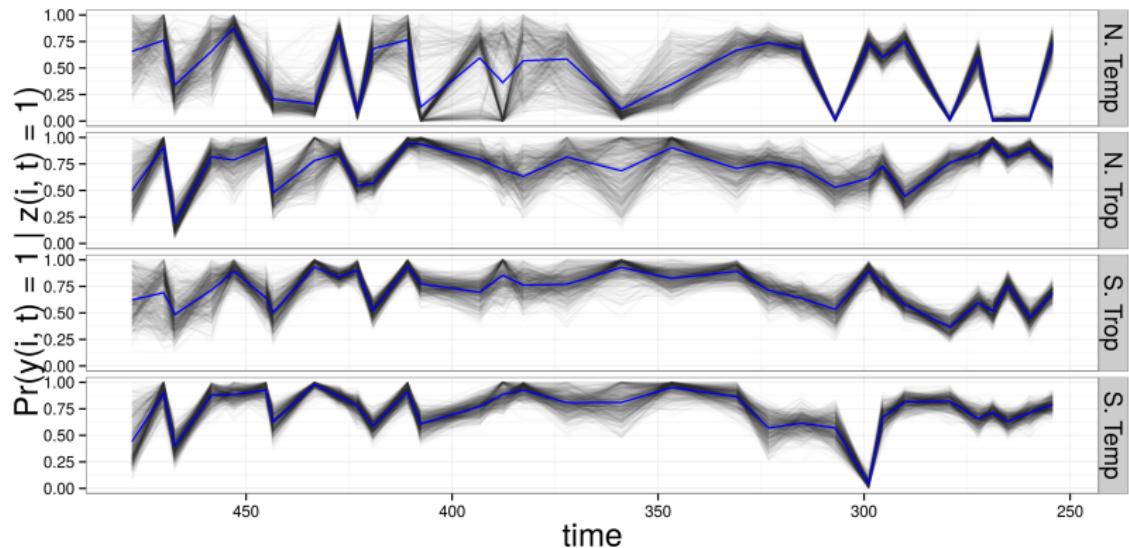
Estimated latent diversity



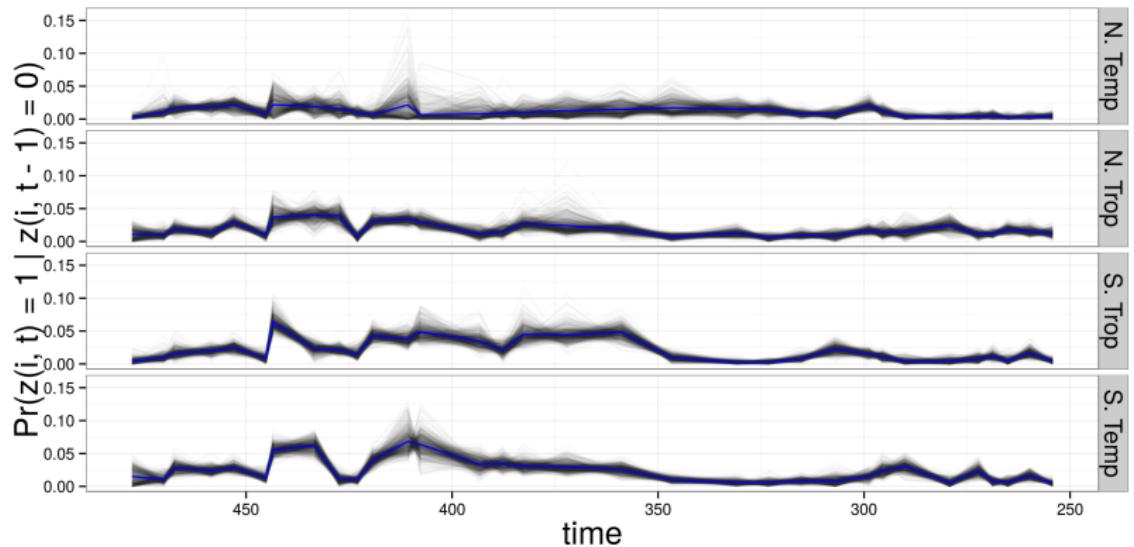
Turnover probability



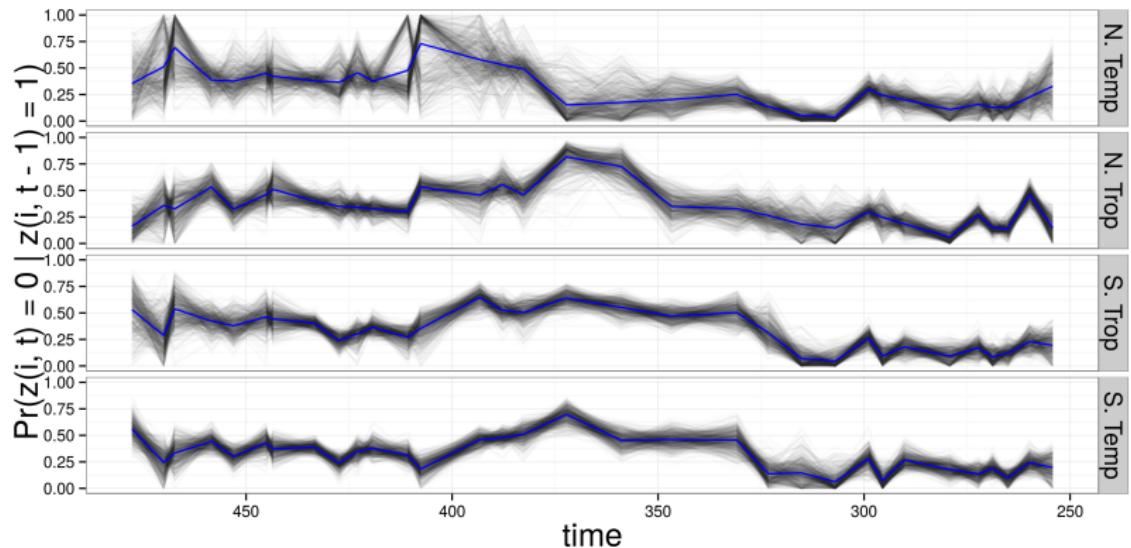
Observation probability



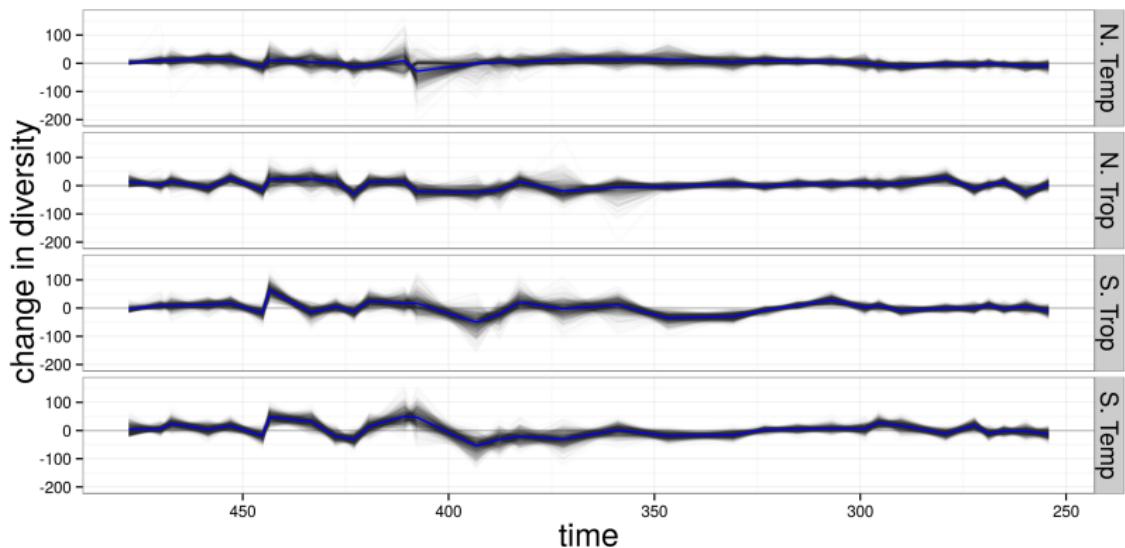
Gain probability



Loss probability



Change in diversity



Major assumptions

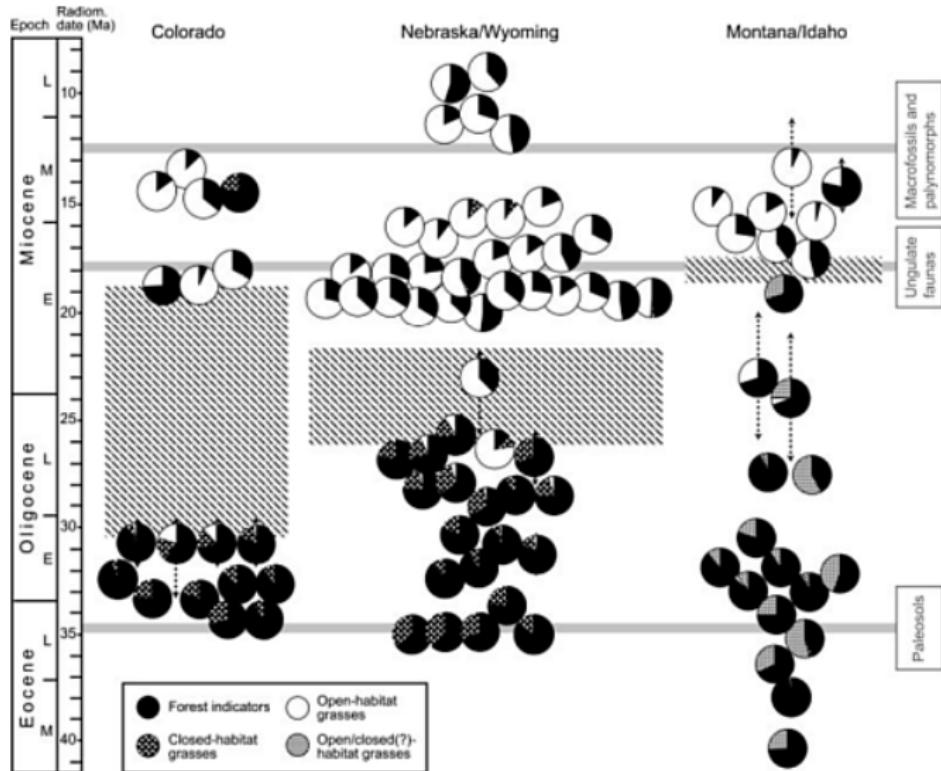
- ▶ first-order Markov process
 - ▶ can lead to some taxa existing longer than in actuality
- ▶ any taxon can occur in any geographic unit independent of other units
- ▶ all of the above possibly controlled for by sampling parameter
 - ▶ further assumes all times and places can be considered similar
- ▶ possible direction
 - ▶ increase taxonomic and/or temporal scope
 - ▶ more latitudinal bands

Changes in Cenozoic mammal ecotype composition

Question

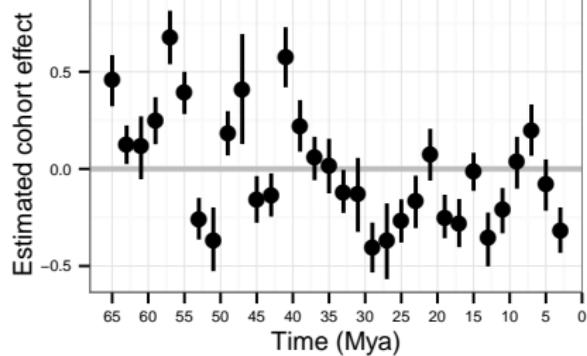
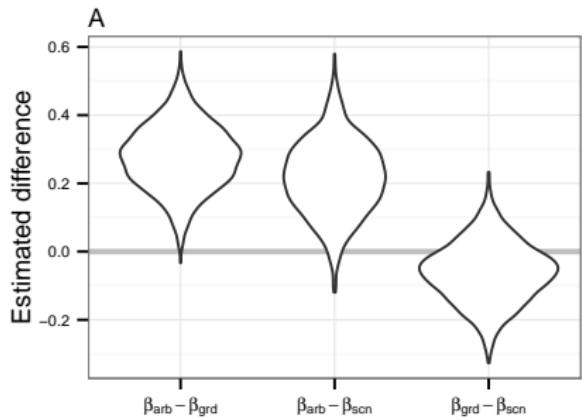
How do occurrence ratios of mammalian ecotypes change over time?

Environmental shift



(Stromberg 2005 PNAS)

Possible link?



(Smits 2015 *PNAS*)

Details and covariates

- ▶ Interest is specifically change in **composition**, and not taxonomic turnover.
- ▶ Covariates
 - ▶ body size of taxon i
 - ▶ dietary category of taxon i
 - ▶ climate (dO18) of time bin j

Multi-logit regression

$$y_i \sim \text{Categorical}(K, \pi)$$

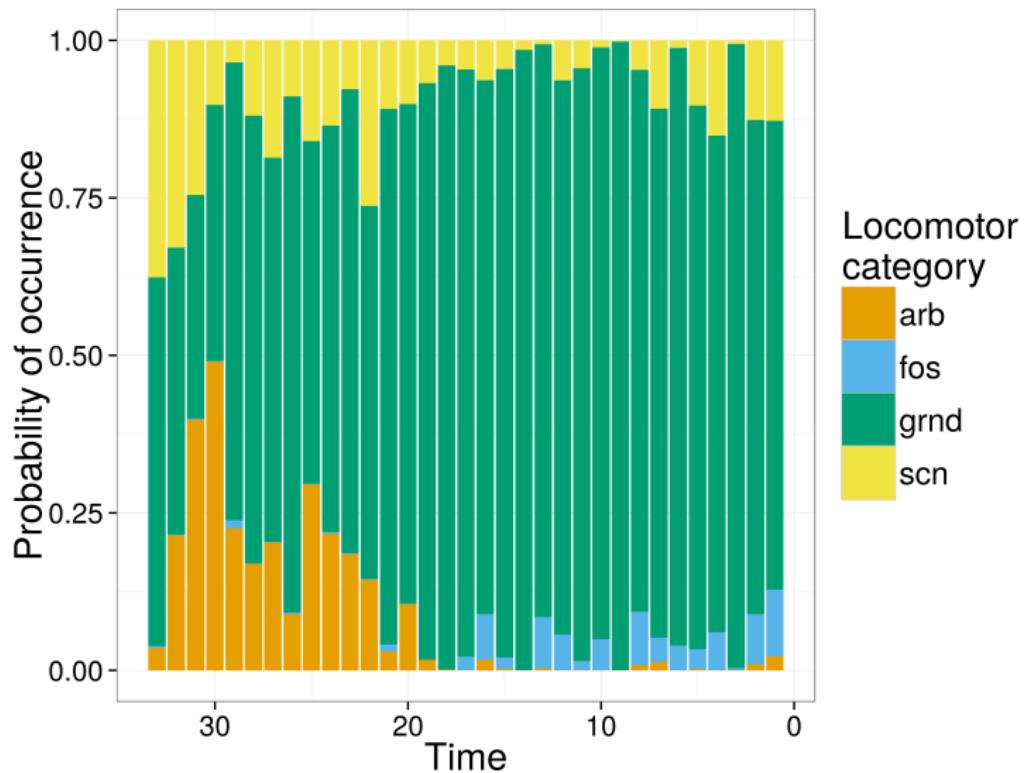
$$\pi_k = \frac{\exp(\beta_{k,j[i]} X_i)}{\sum_{k=1}^K \exp(\beta_{k,j[i]} X_i)}$$

$$\text{where } \beta_{K,j[i]} X_i = 0$$

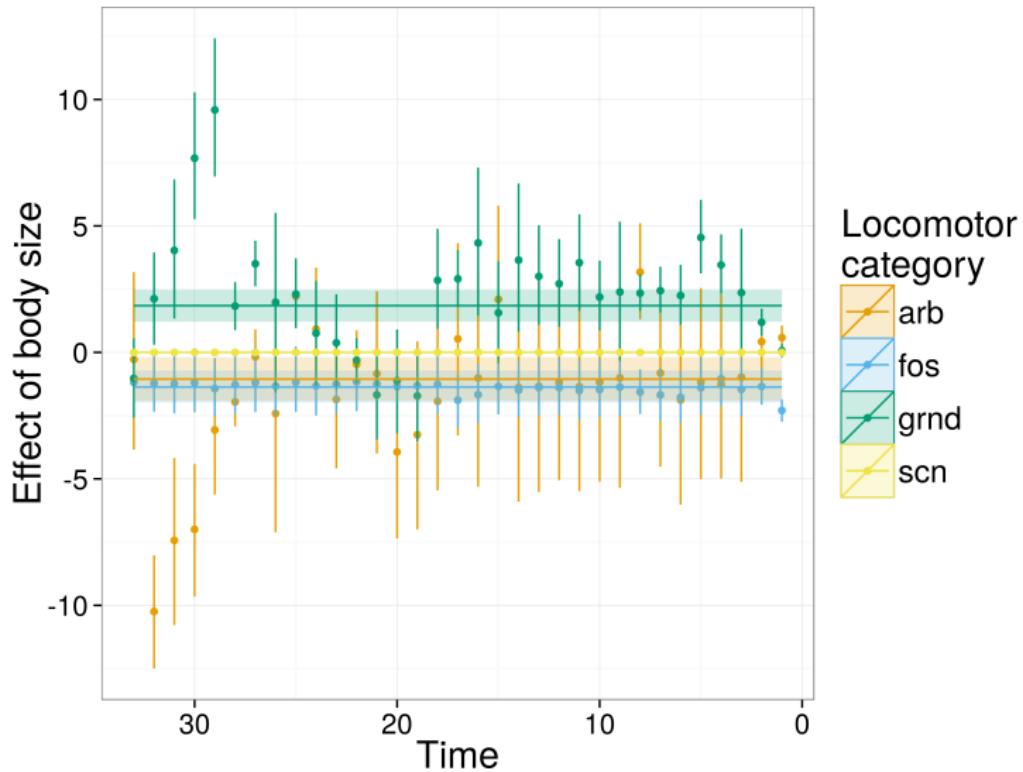
$$\beta_{k,j} \sim \mathcal{N}(\beta'_k, \sigma_k)$$

$$\beta_{k,j}[1] \sim \mathcal{N}(\beta'_k[1] + \alpha_k U_k, \sigma_k)$$

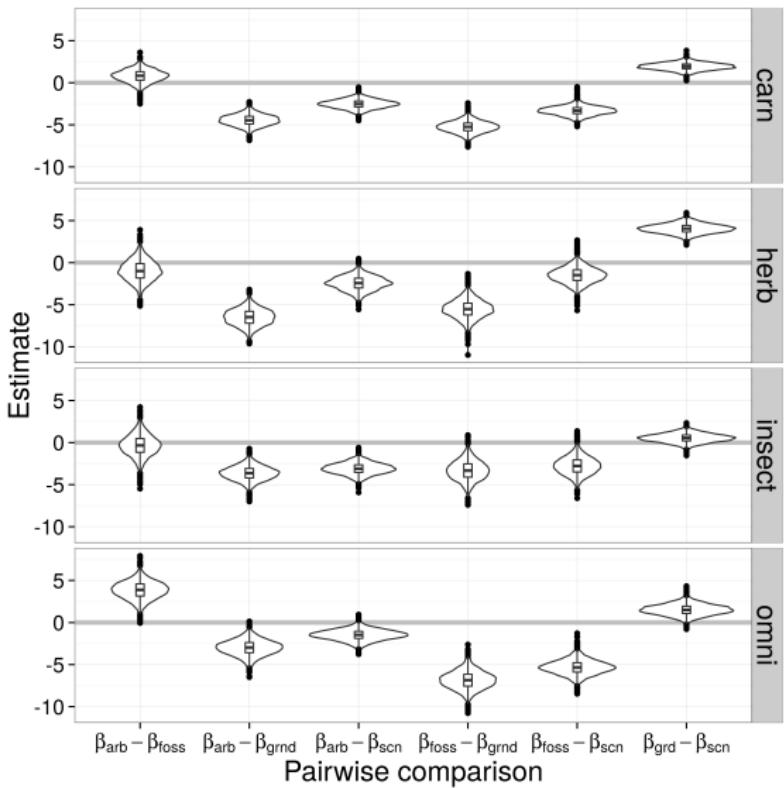
Change in occurrence ratio over time



Effect of body size on occurrence probability



Effect of dietary category on occurrence probability



Further developments

- ▶ NOTE currently single flat mean; allow trend/multiple?
 - ▶ time order is not currently modeled
- ▶ phylogenetic effect to be included (except $k = K$)
- ▶ climate as cohort-level predictor, integrating over uncertainty?
- ▶ 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?