Gambling with Australian brachiopods

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Gambler's Ruin

Definition

Given infinite time, all gambler's go bust.

Death of a taxon

Taxa as gamblers

All taxa, given infinite time, go extinct.

Foundation

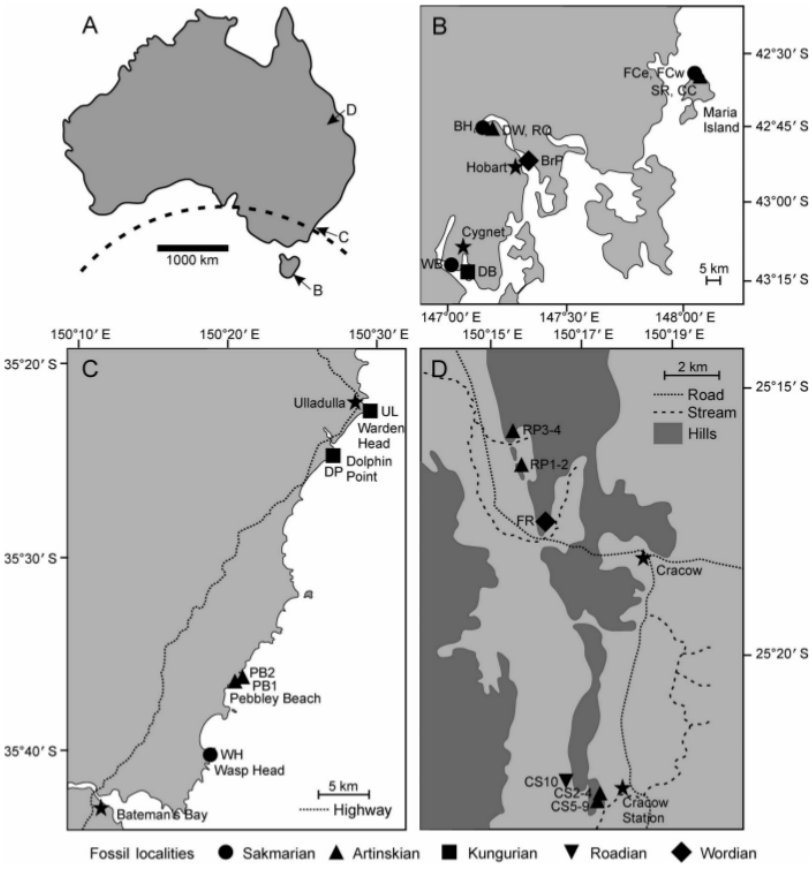
Question

Why do taxa go extinct at different rates?

Enter brachiopods

(Immersion Imagery, Shutterstock; Wikimedia)

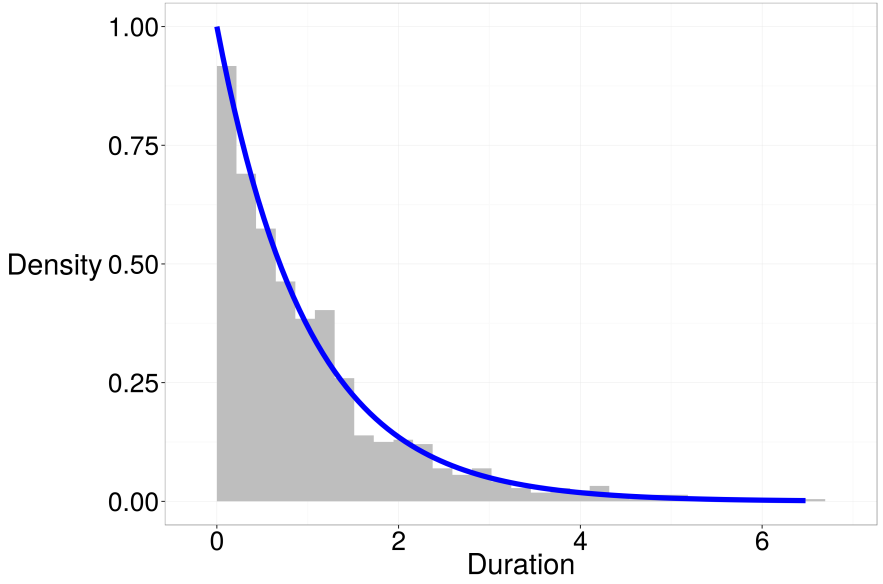
System details

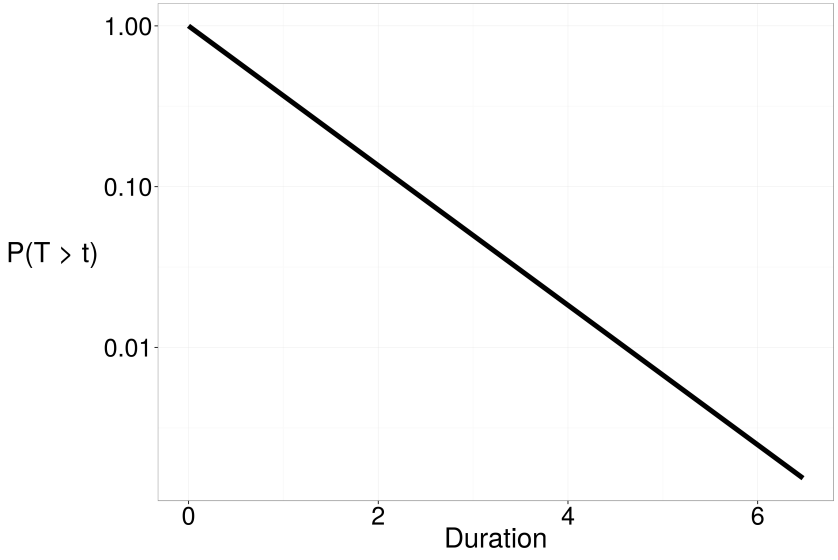


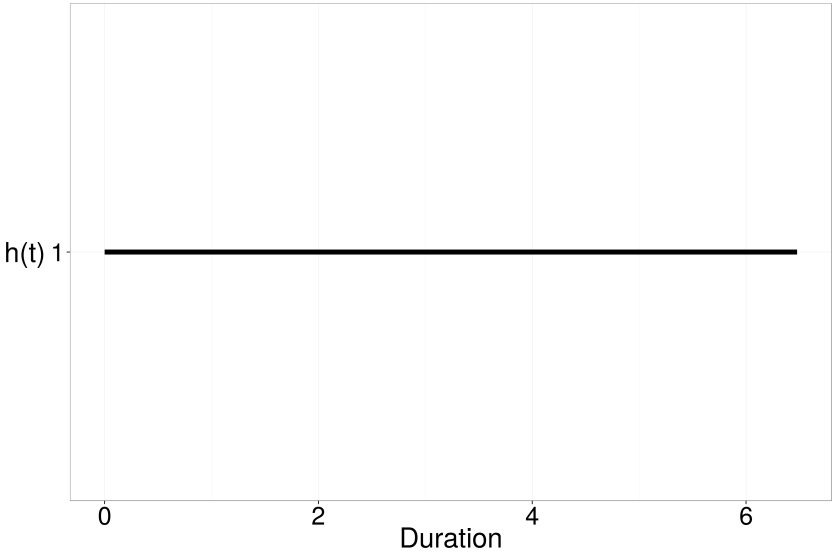
(Clapham and James 2008 *Palaios*)

- Australian Permian
  - range in/out taxa right censored
- predictors
  - substrate probability
  - onshore/offshore probability
  - body size (Payne *et al.* 2014 *Proc. B*)
  - occupancy (see Vilhena *et al.* 2014 *Nature Com.*)

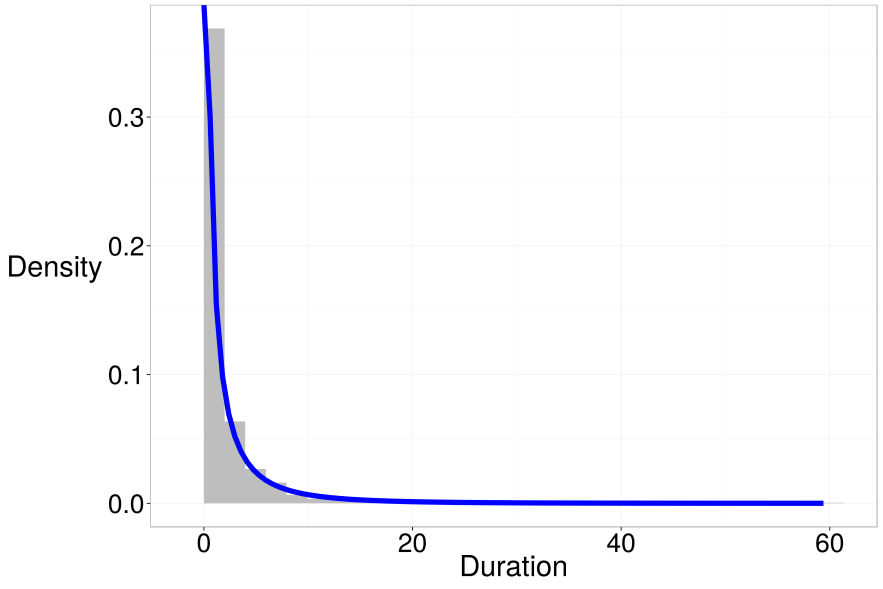
Survival analysis: constant extinction

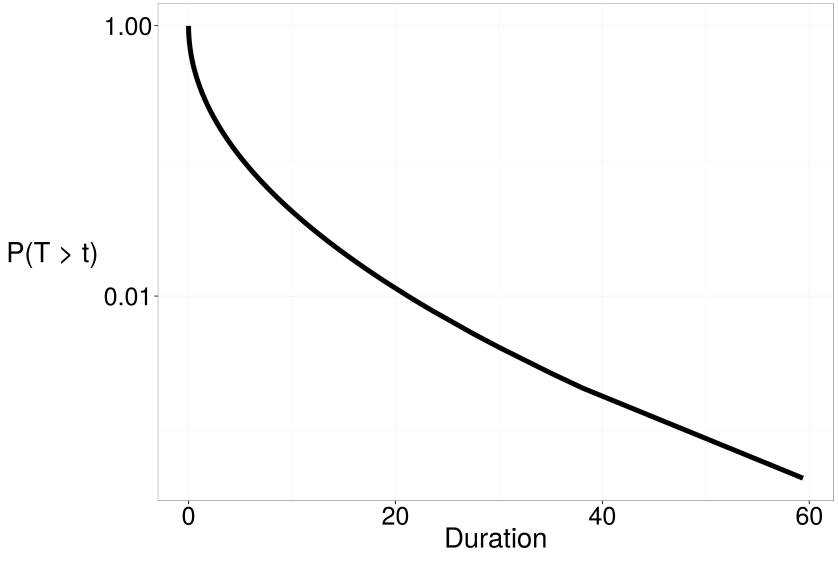


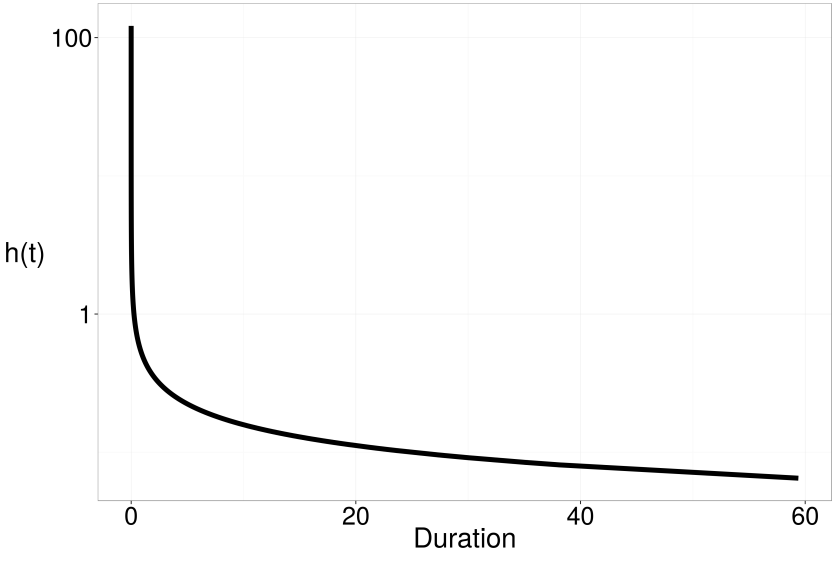




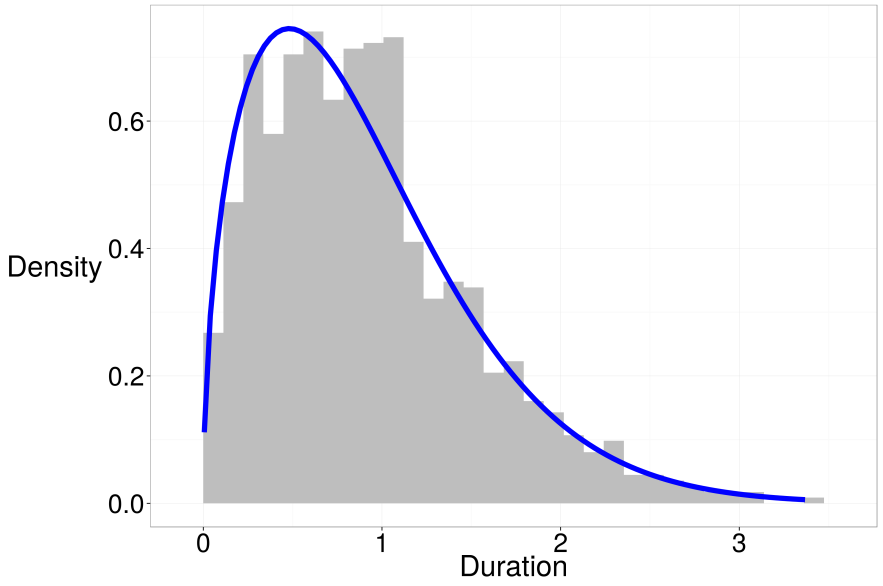
Survival analysis: decelerating extinction (k < 1)

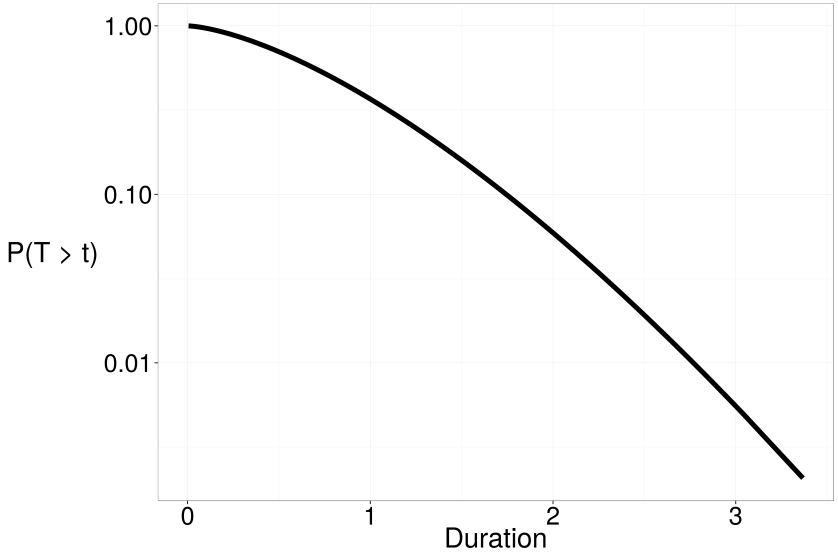


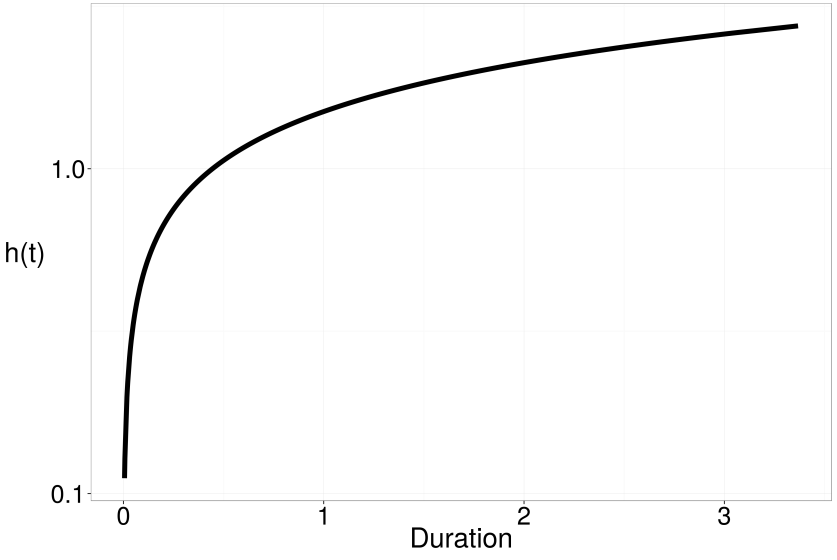




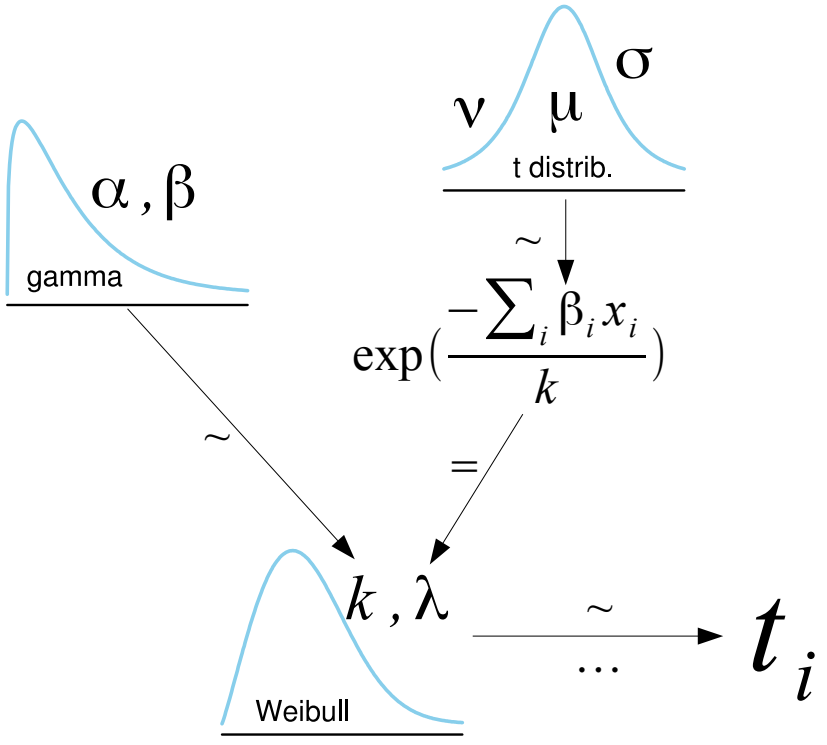
Survival analysis: accelerating extinction (k > 1)





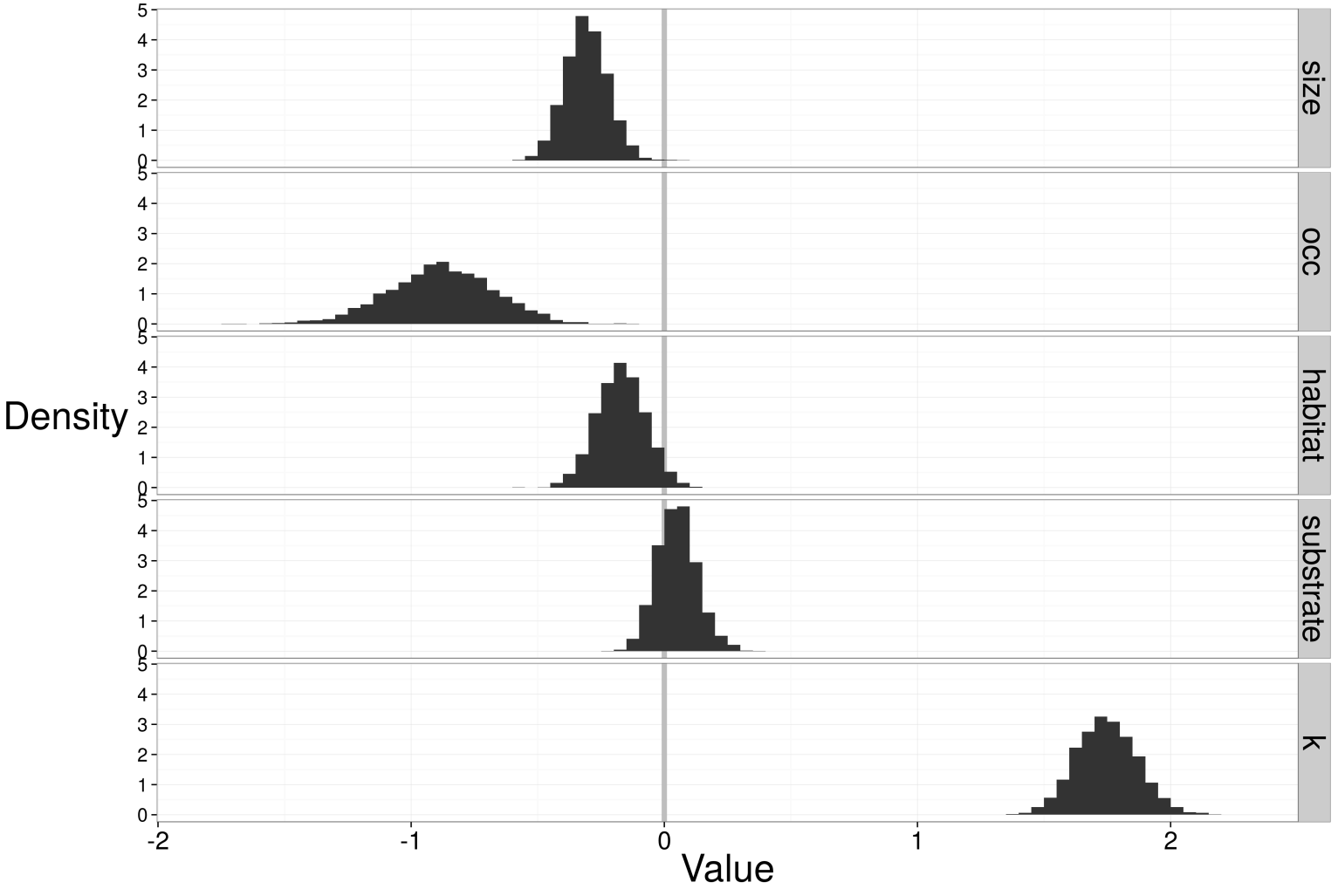


Bayesian model structure

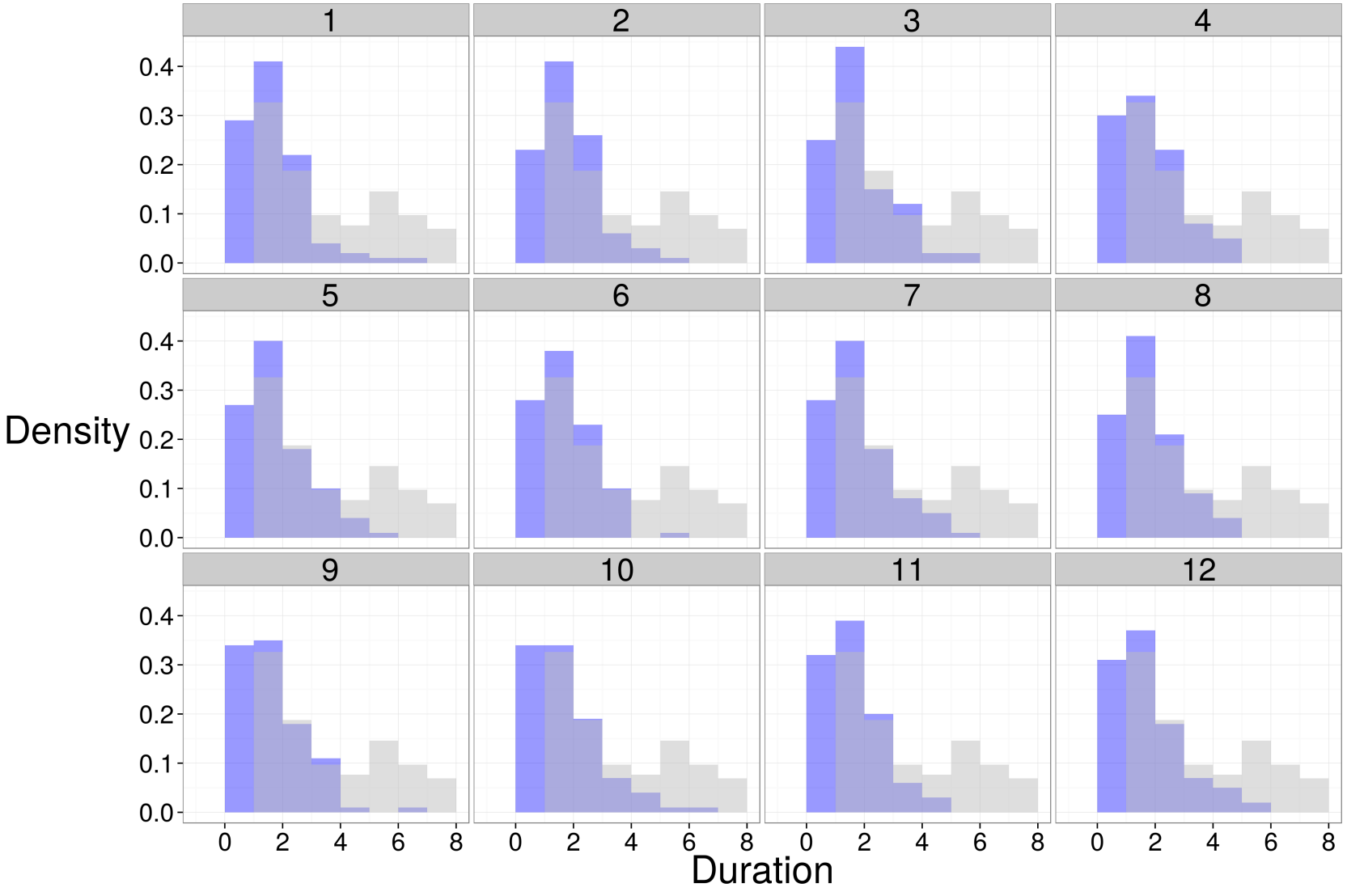


Parameter marginal posteriors

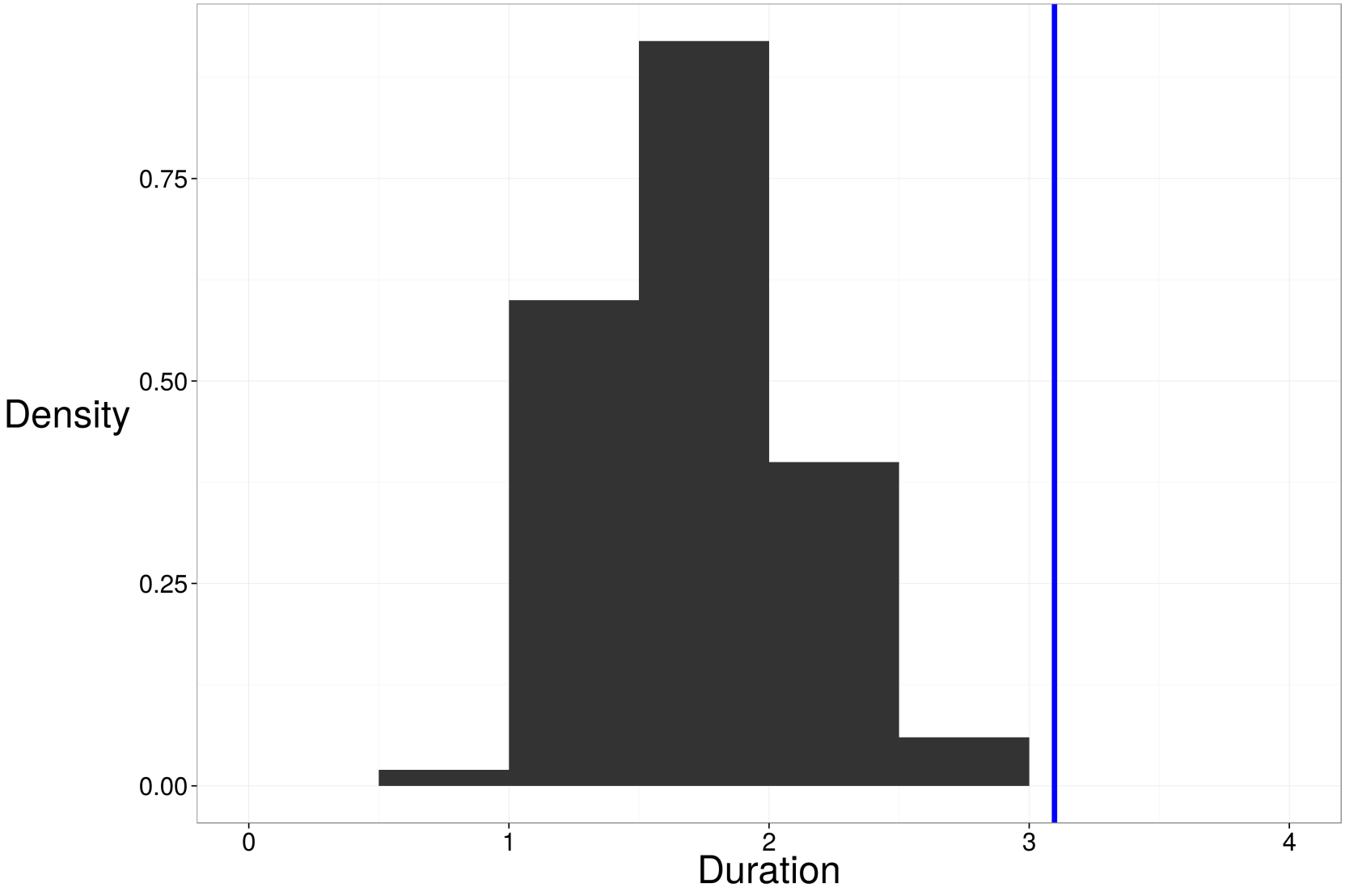
For all but k, if farther to left then $\uparrow$ trait $\propto \uparrow$ duration.



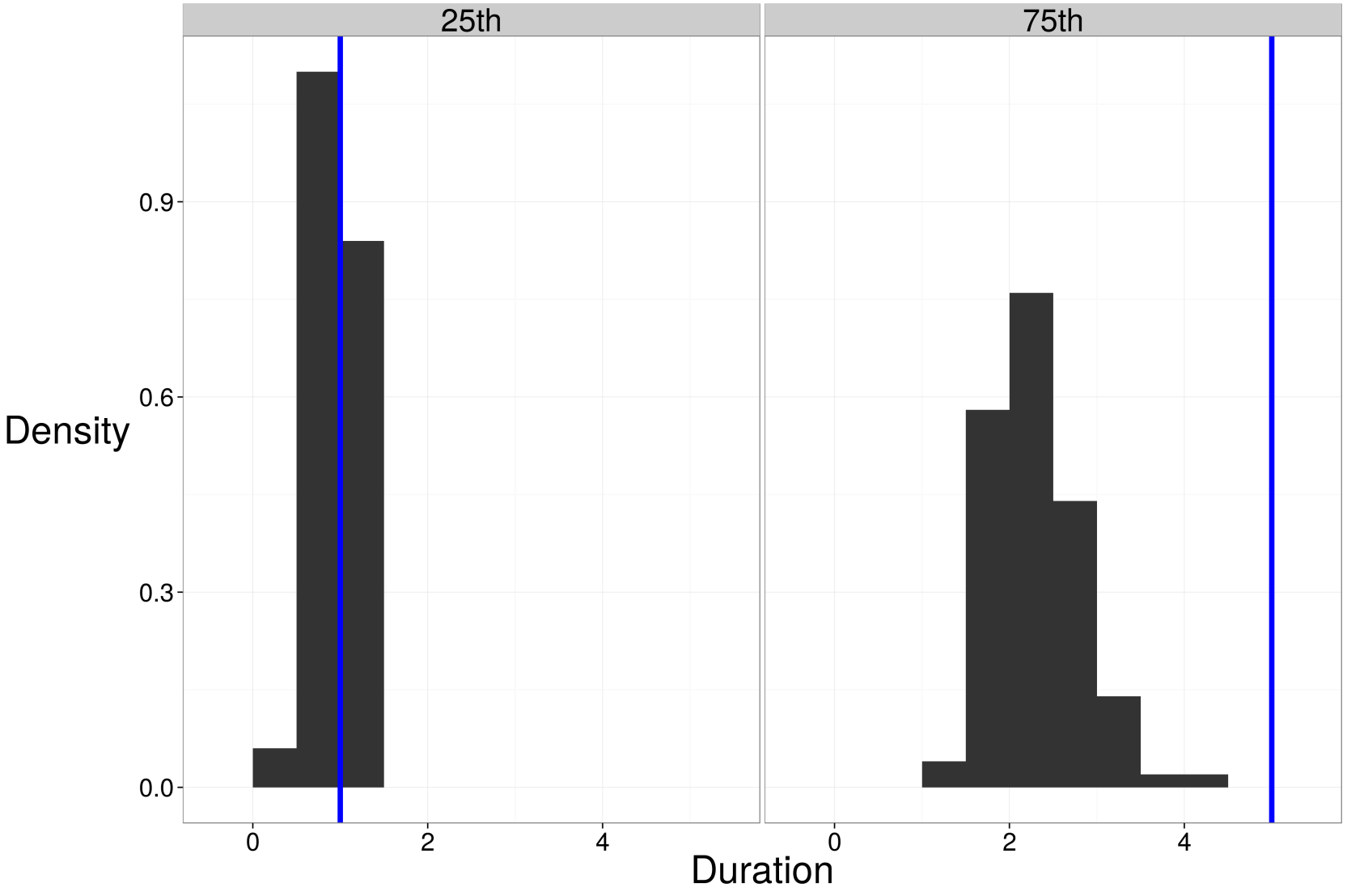
Estimated versus observed: distribution



Estimated versus observed: mean duration



Estimated versus observed: quantiles



State of knowledge

Preliminary conclusions

Little evidence for age-independent pattern.

Occupancy has largest effect.

P(carbonate | occurrences) $\approx$ no effect.

Modeling improvements

Major roadblock

HEAVY RIGHT TAIL

- sampling distribution
  - three-parameter Weibull
  - mixture of distributions
- different priors
- non-linear/heterogeneous variance
- fossil sampling effect

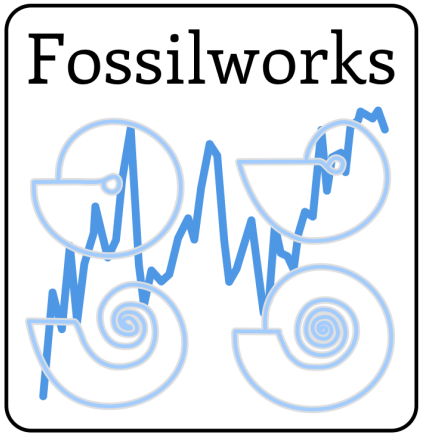
Remember. . .

Analysis is a narrative

- fit model
- evaluate model
- improve model/include more information

Acknowledgements

- Advising
  - Kenneth D. Angielczyk, Michael J. Foote, P. David Polly, Richard H. Ree
- Discussion
  - David Bapst, Marites Villarosa Garcia, Gene Hunt, Nadia Pierrehumbert



The Paleobiology Database
revealing the history of life