

# 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

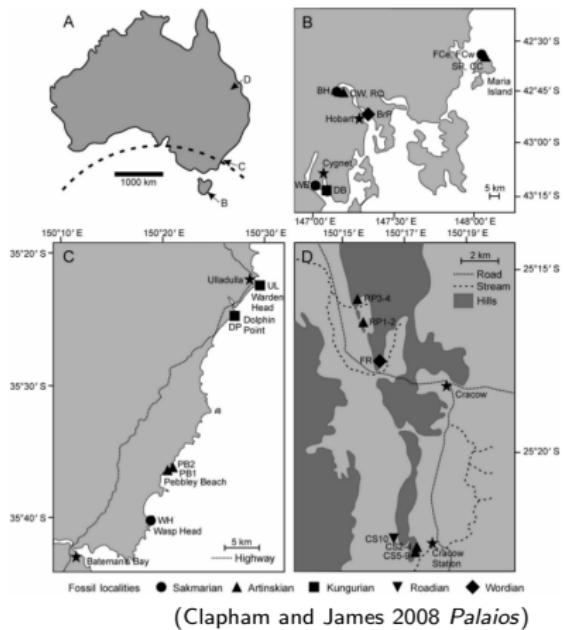
Why do taxa go extinct at **different rates**?

# Enter brachiopods



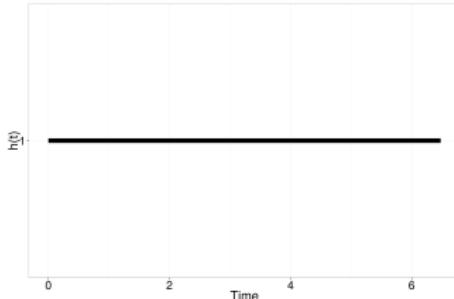
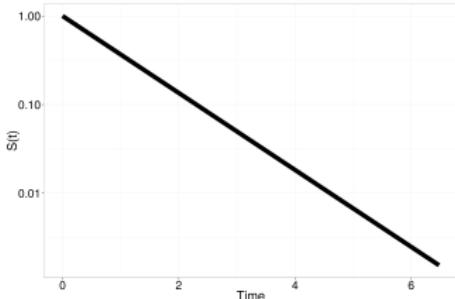
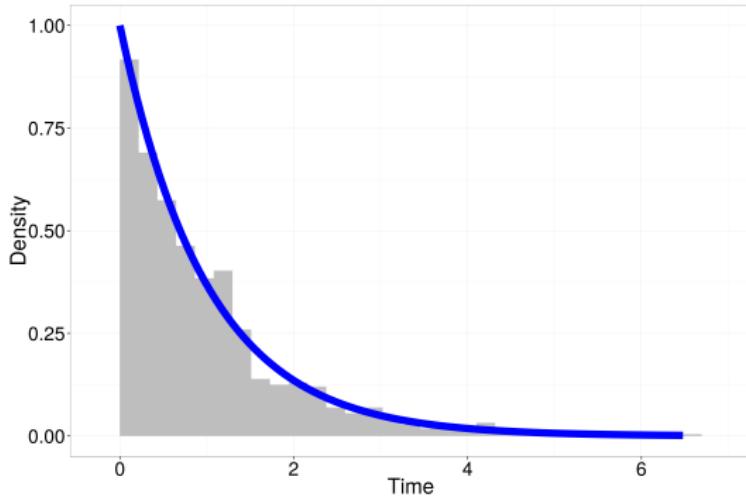
(Immersion Imagery, Shutterstock; Wikimedia)

# System details

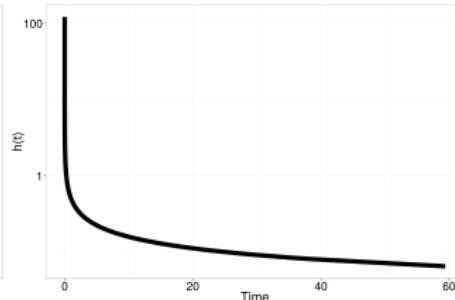
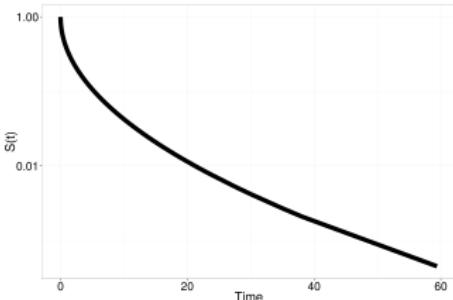
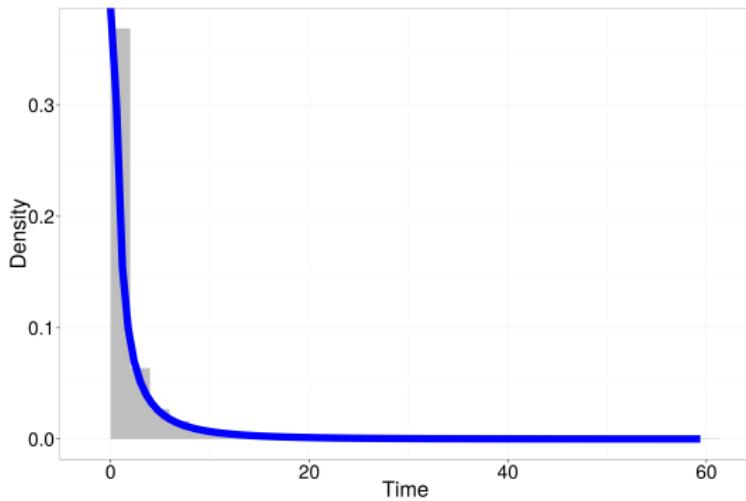


- ▶ Australian Permian
  - ▶ range in/out taxa right censored
- ▶ predictors
  - ▶ substrate probability (fully Bayesian approach)
  - ▶ onshore/offshore
  - ▶ body size (Payne *et al.* 2014 *Proc. B*)
  - ▶ occupancy (see Vilhena *et al.* 2014 *Nature Com.*)

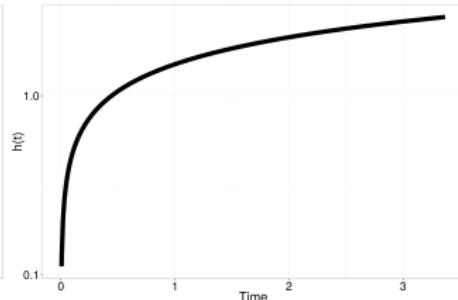
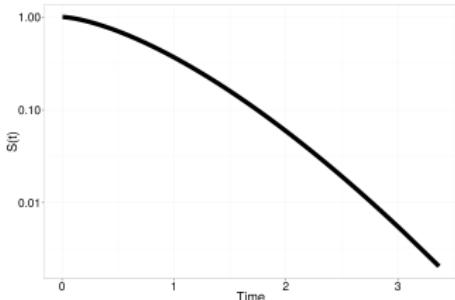
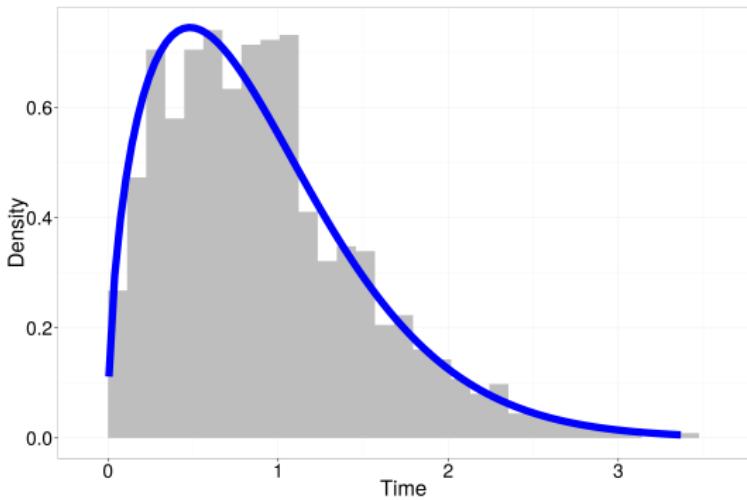
# Survival analysis



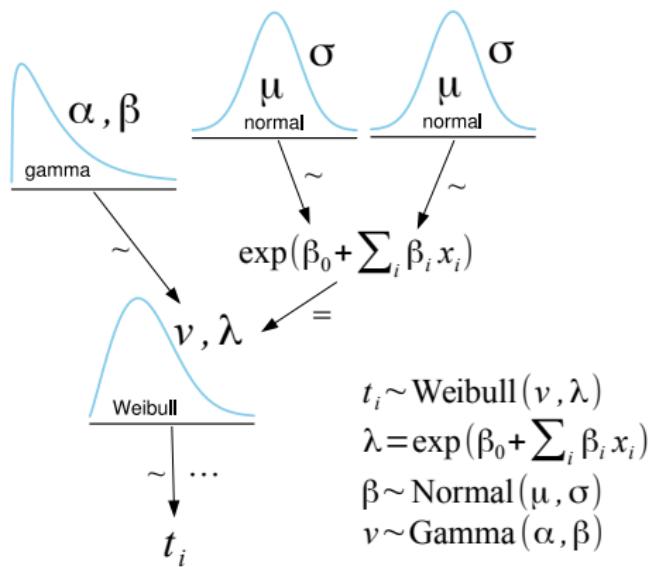
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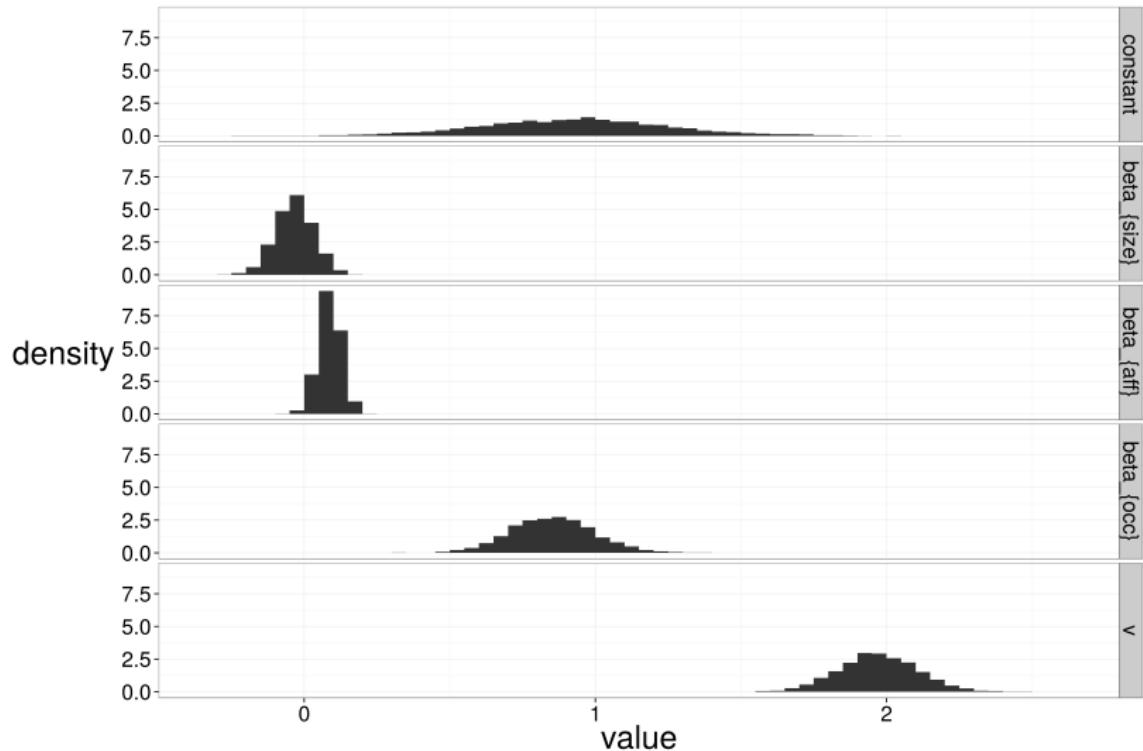
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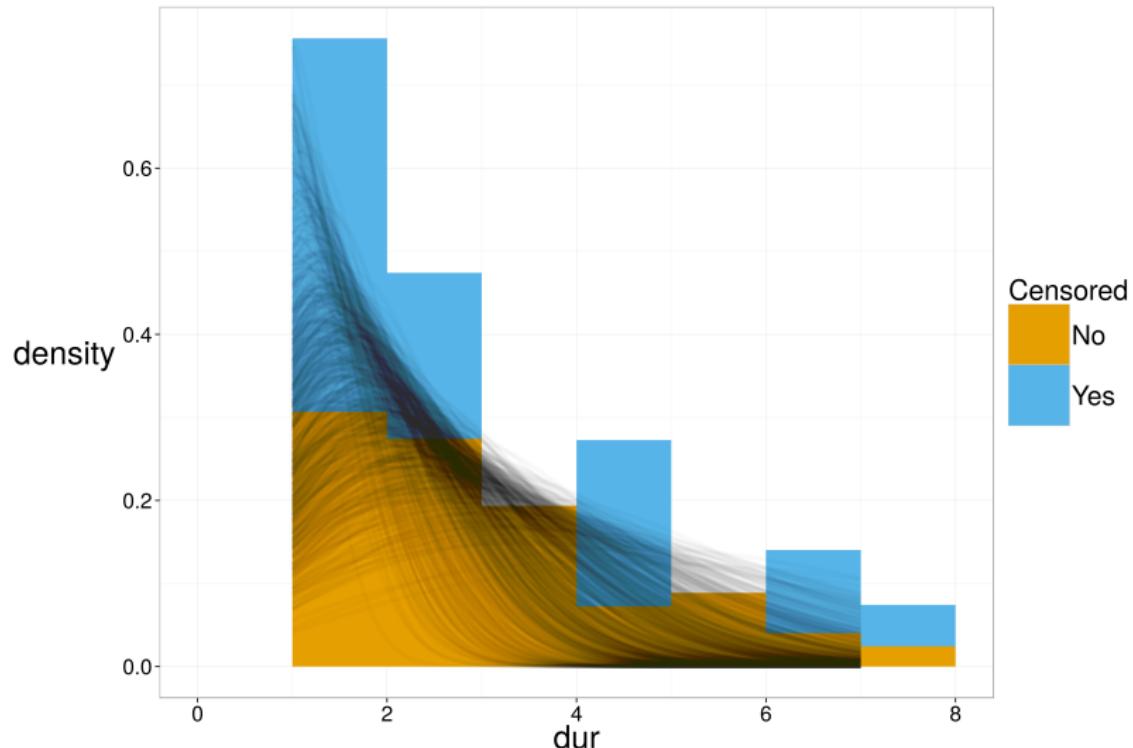
# Bayesian model structure



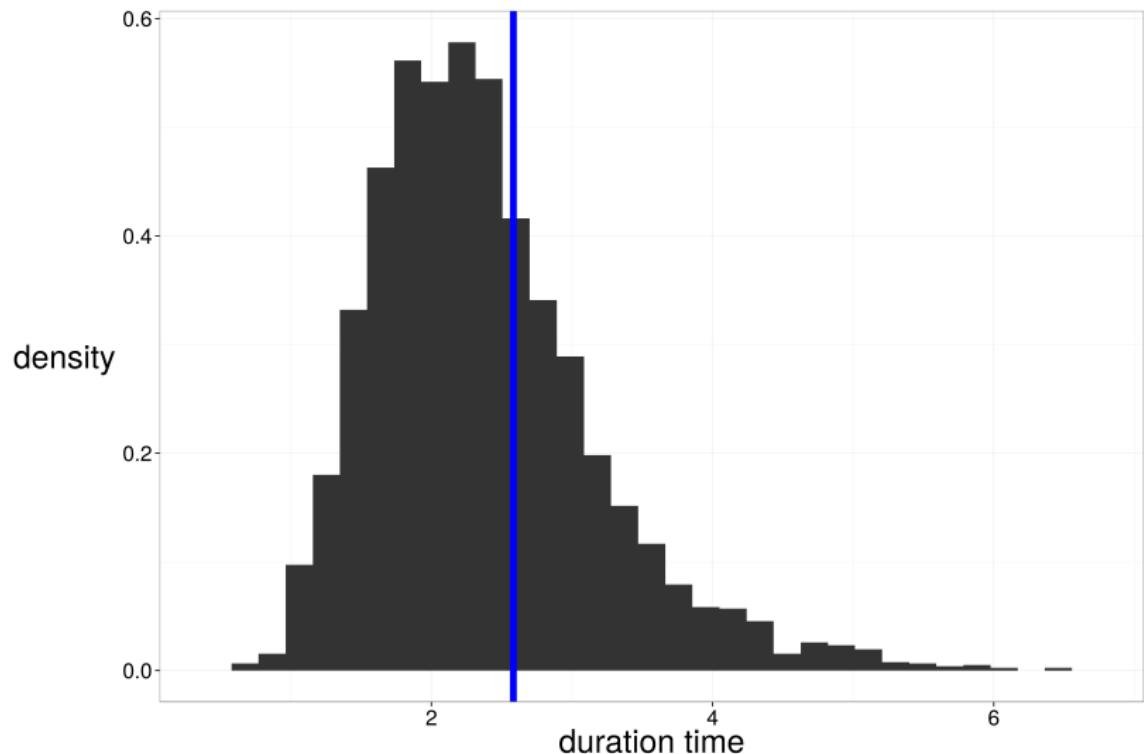
# Parameter marginal posteriors



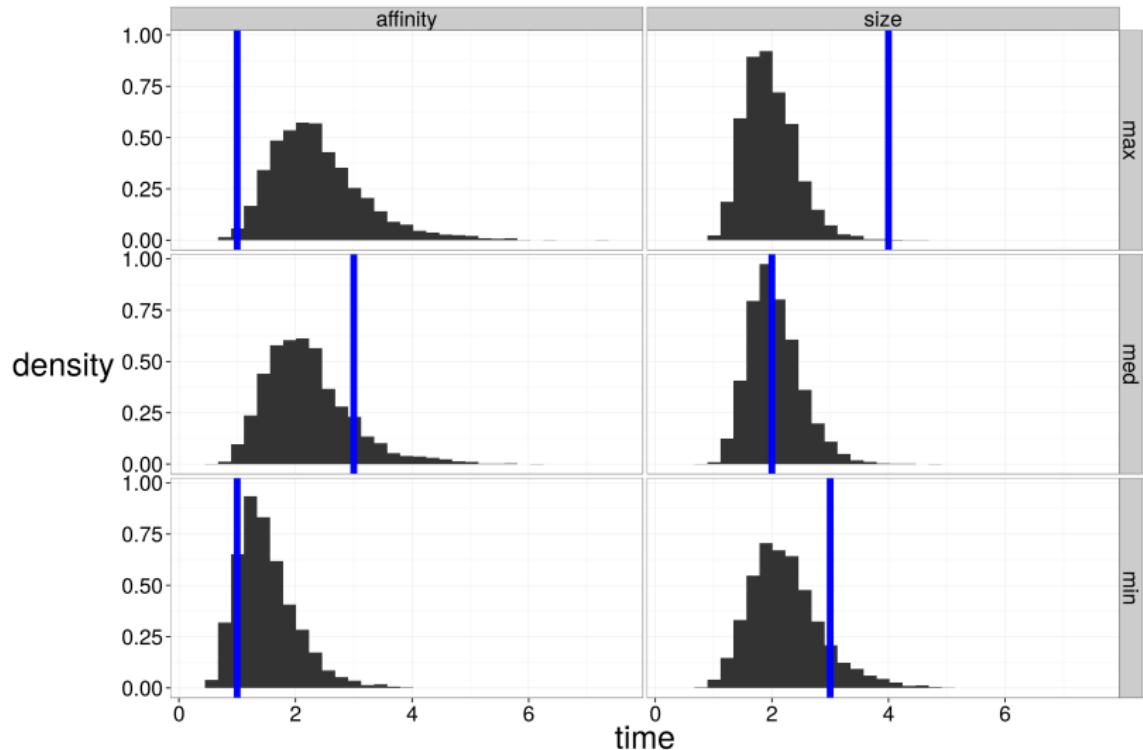
# Durations



## Posterior predictive check: mean duration



## Posterior predictive checks: traits



# State of knowledge

## Conclusions

Extinction is age-dependent ( $v > 1$ ).

Occupancy has largest effects.

Possible nonlinear effect of size and affinity.

Model is not fully capturing variance.

# Improvements

- ▶ Data
  - ▶ New Zealand (FRED)
  - ▶ improved paleoenvironment reconstructions
  - ▶ affixing strategy information
- ▶ Model
  - ▶ extended sensitivity analysis
  - ▶ robust priors ( $t$ -distribution)
  - ▶ substrate, habitat as distributions (fully hierarchical model) or just make categorical?
  - ▶ effect of sampling

# Acknowledgements

- ▶ Advising

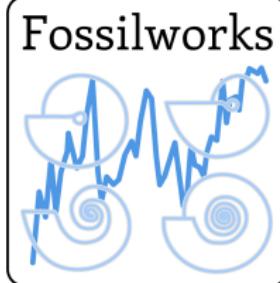
- ▶ Kenneth D. Angielczyk,  
Michael J. Foote,  
P. David Polly,  
Richard H. Ree

- ▶ Discussion

- ▶ David Bapst,  
Megan Boatright,  
Ben Frable,  
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Ross, Liz Sander,  
Carl Simpson



The Field  
Museum



The Paleobiology Database  
revealing the history of life