Cenozoic mammals and the biology of extinction

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March 31, 2014

Extinction

All species that have ever lived are, to a first approximation, dead.

(Raup 1986 The Nemesis Affair)

Foundation

Question

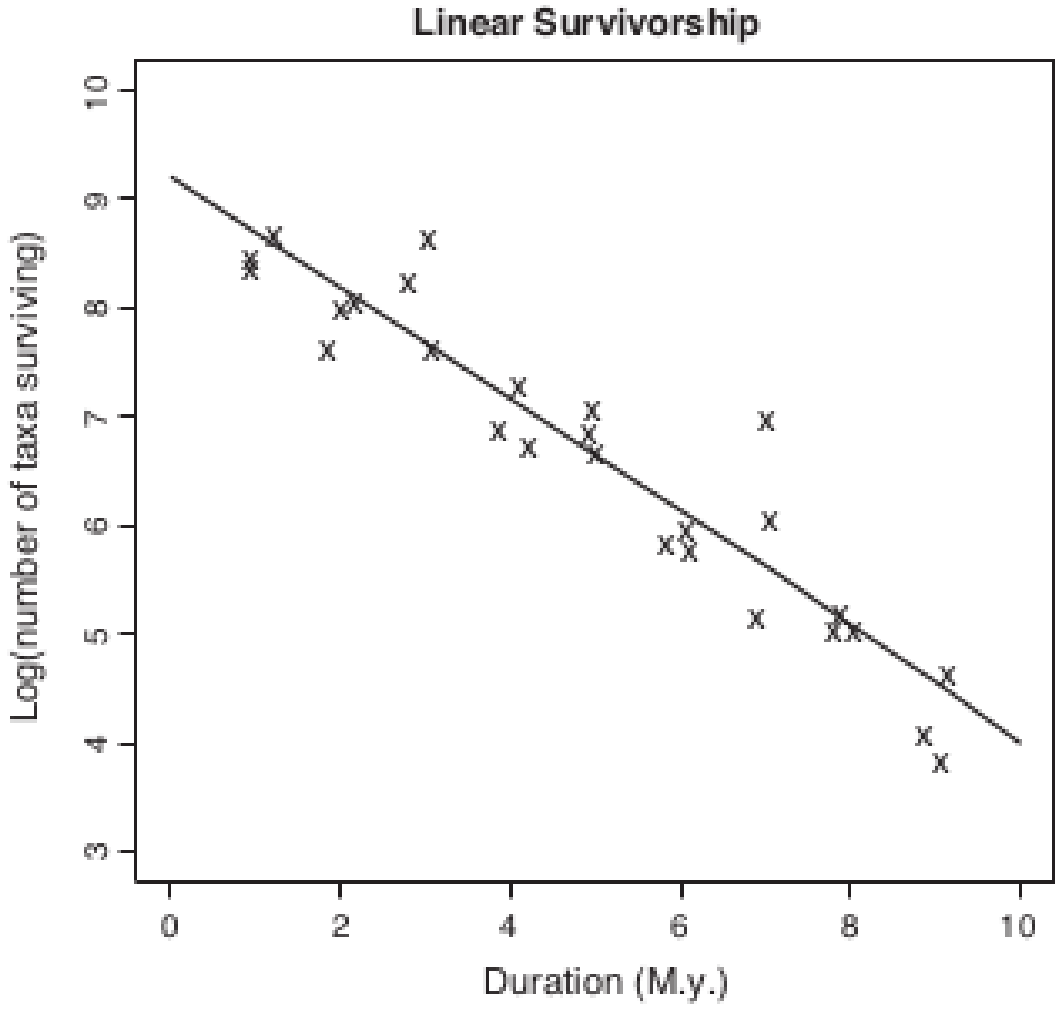
Why do certain taxa go extinct while others do not?

In context of this study

Rephrased

How does a taxon's adaptive zone affect extinction risk?

Van Valen's observation



(Liow et al. 2011 *TREE*)

Law of Constant Extinction

Definition

Extinction rate, in a given adaptive zone, is taxon–age independent.

(Van Valen 1973 *Evol. Theory*)

Biology and extinction

Questions

- Do traits related to environmental preference have different distributions of taxonomic duration?
  - Is survival best modeled by a single trait or multiple?
  - How do other factors, such as climate, affect these patterns?
- Is extinction taxon-age independent or dependent?
- Do genera and species have fundamentally different survival distributions?

Survival analysis

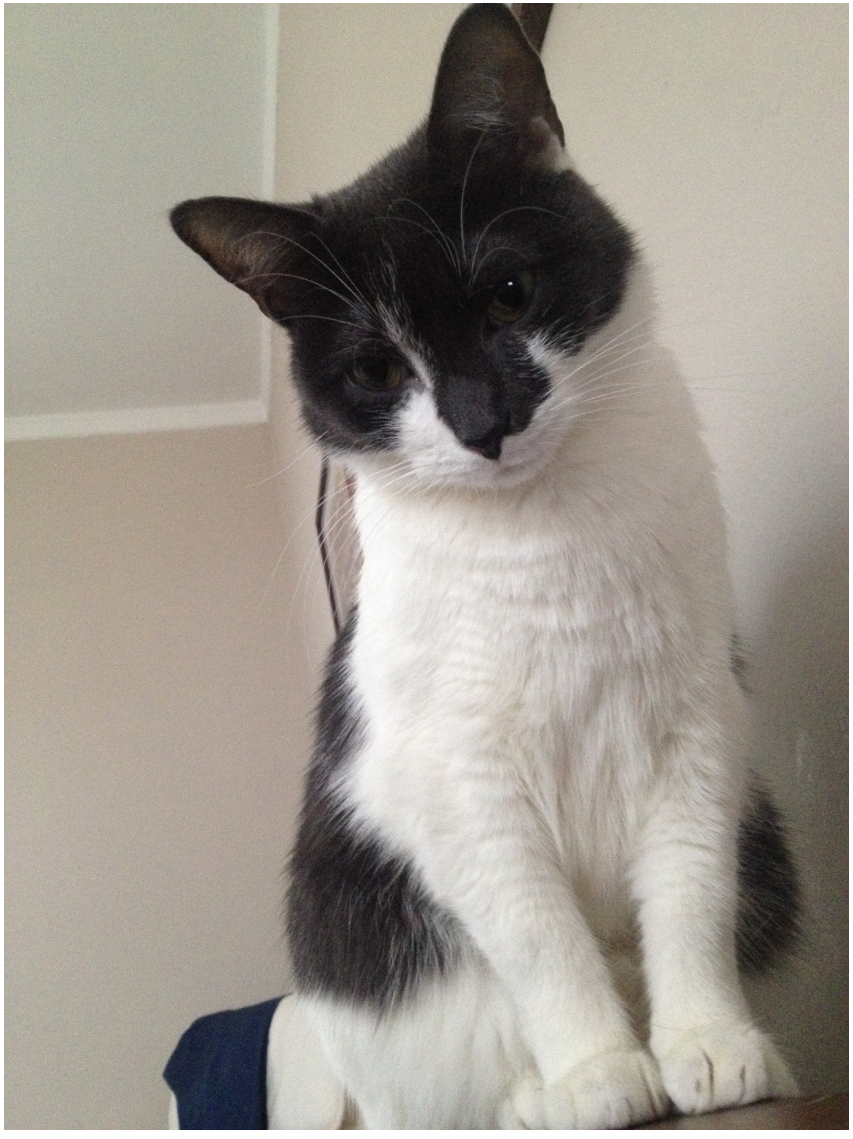
Formalization of Van Valen

Law of Constant Extinction

Hazard is constant with respect to time (exponential survival).

$$h(t) = \lambda \iff S(t) = \exp^{-\lambda t}$$

Study system



- Mammals
- Cenozoic ($\sim$ 65 My)
- North America, Europe, South America
- traits
  - diet: carnivore, herbivore, omnivore, insectivore
  - locomotion: ground dwelling, arboreal, scansorial
  - body size

Approach

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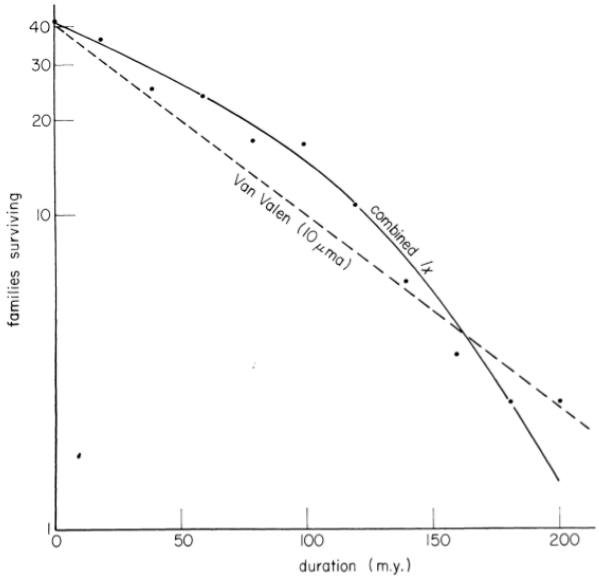
Acknowledgements

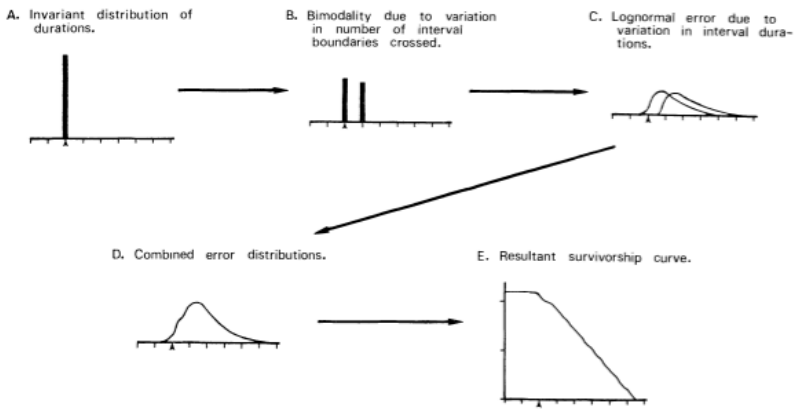
- **Committee**
  - Kenneth D. Angielczyk (co-advisor)
  - Michael J. Foote (co-advisor)
  - P. David Polly
  - Richard H. Ree
- Discussion
  - David Bapst, Megan Boatright, Ben Frable, Colin Kyle, Darcy Ross, Liz Sander
  - John Alroy, Graeme Lloyd, Carl Simpson, Graham Slater

The Field Museum

Differential preservation and survival



(Raup 1975 *Paleobio.*)



(Sepkoski 1975 *Paleobio.*)

two groups in four scenarios

- = birth, death; =preservation
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