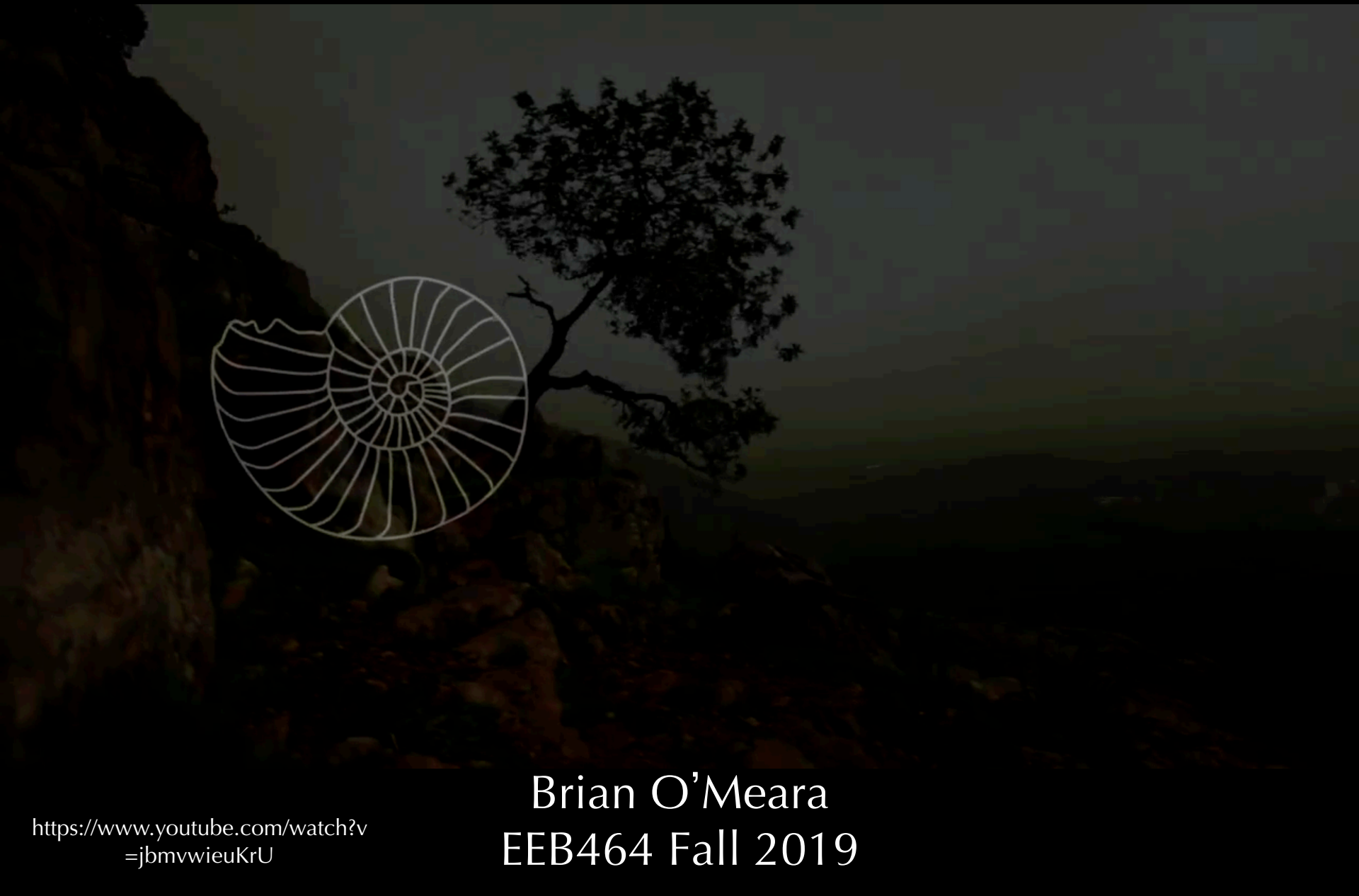
Extinction 1



Brian O'Meara
EEB464 Fall 2019

https://www.youtube.com/watch?v=jbmvwieuKrU

- Major extinctions
- Background extinction
- Modern extinctions
  - Amphibian decline
  - White Nose Syndrome
  - Vaquita
- Selectivity

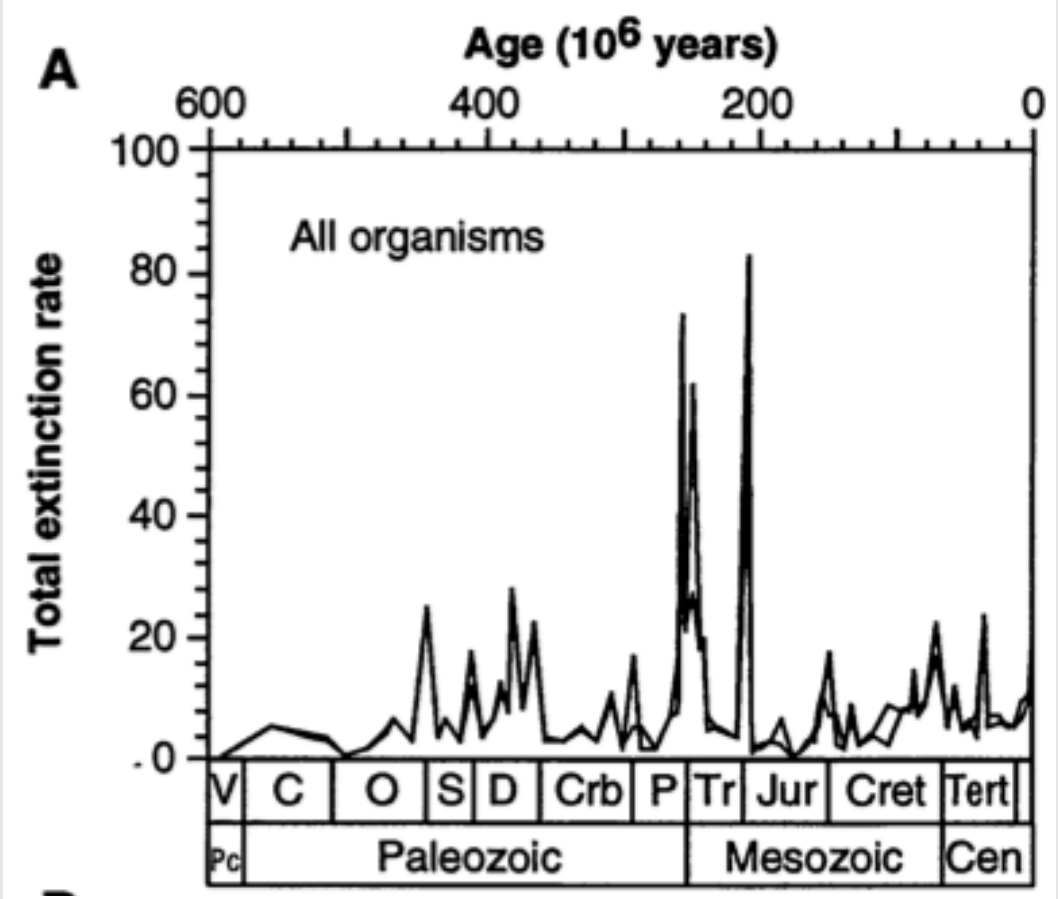


Fig. 6. Patterns of family extinctions through time plotted for all organisms (**A**), continental organisms (**B**), and marine organisms (**C**) in terms of the total extinction rate, that is, the numbers of families that died out in relation to the duration of each stratigraphic stage. Maximum and minimum curves are shown, and abbreviations are as in Fig. 1.

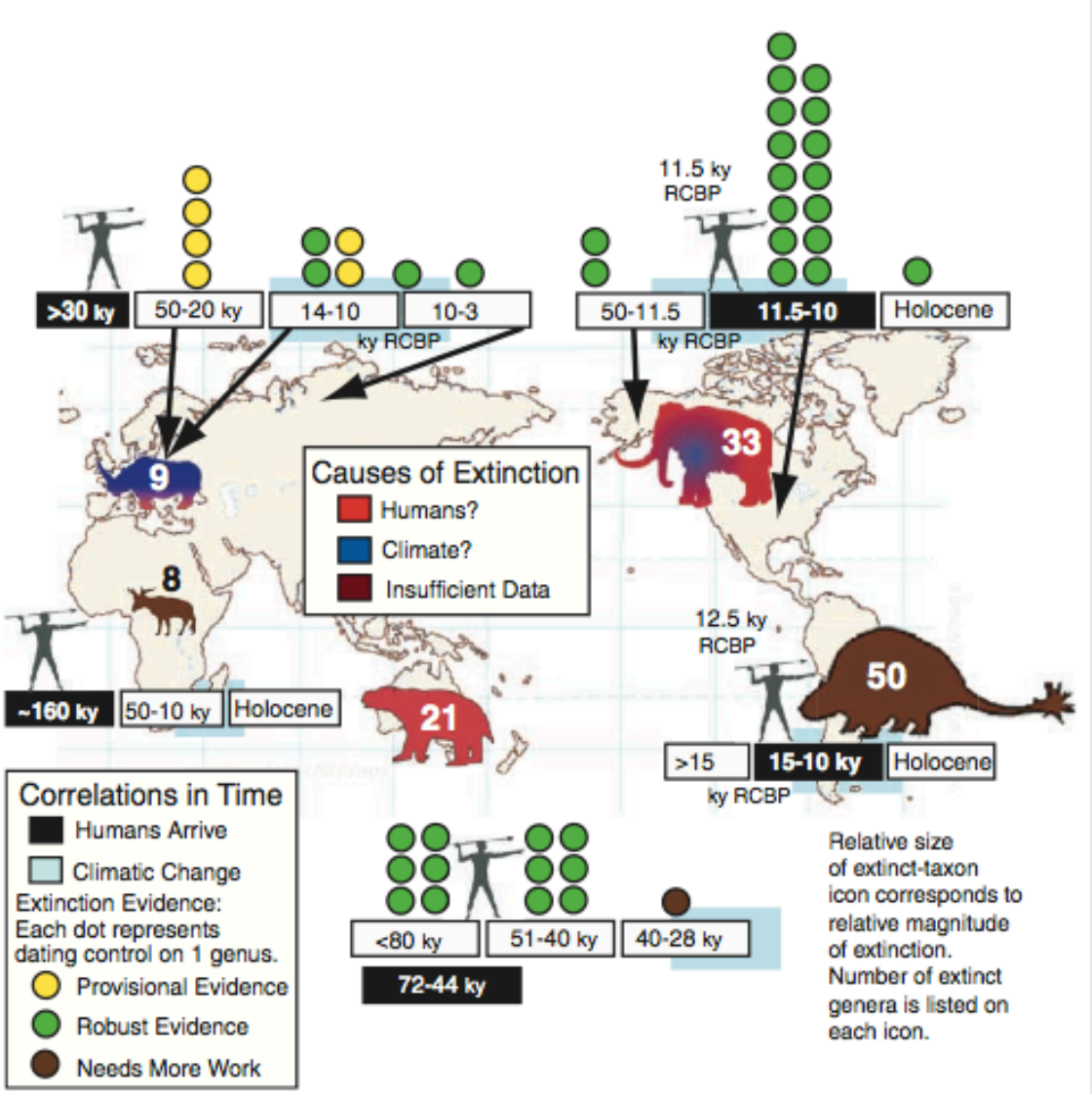
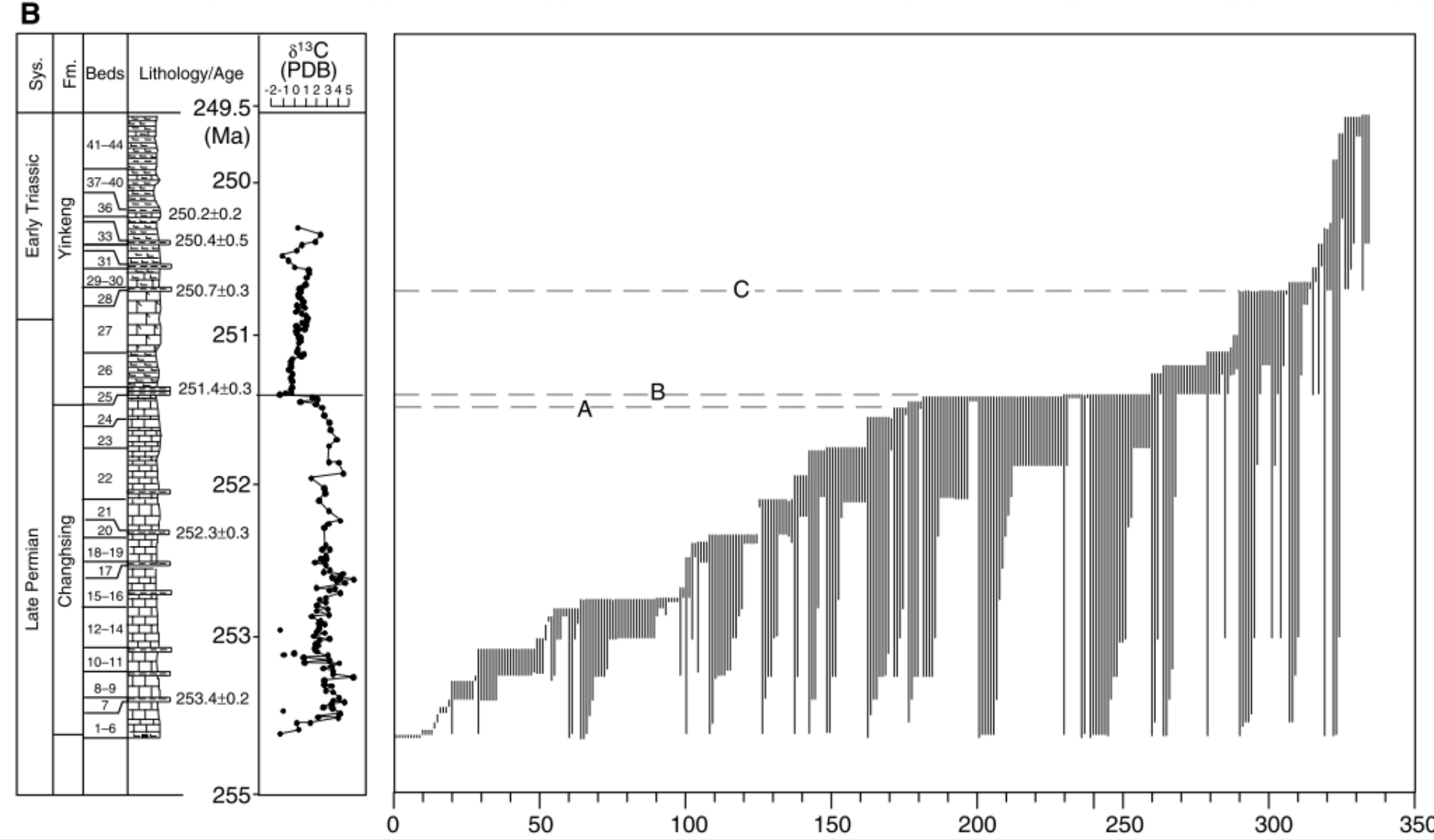


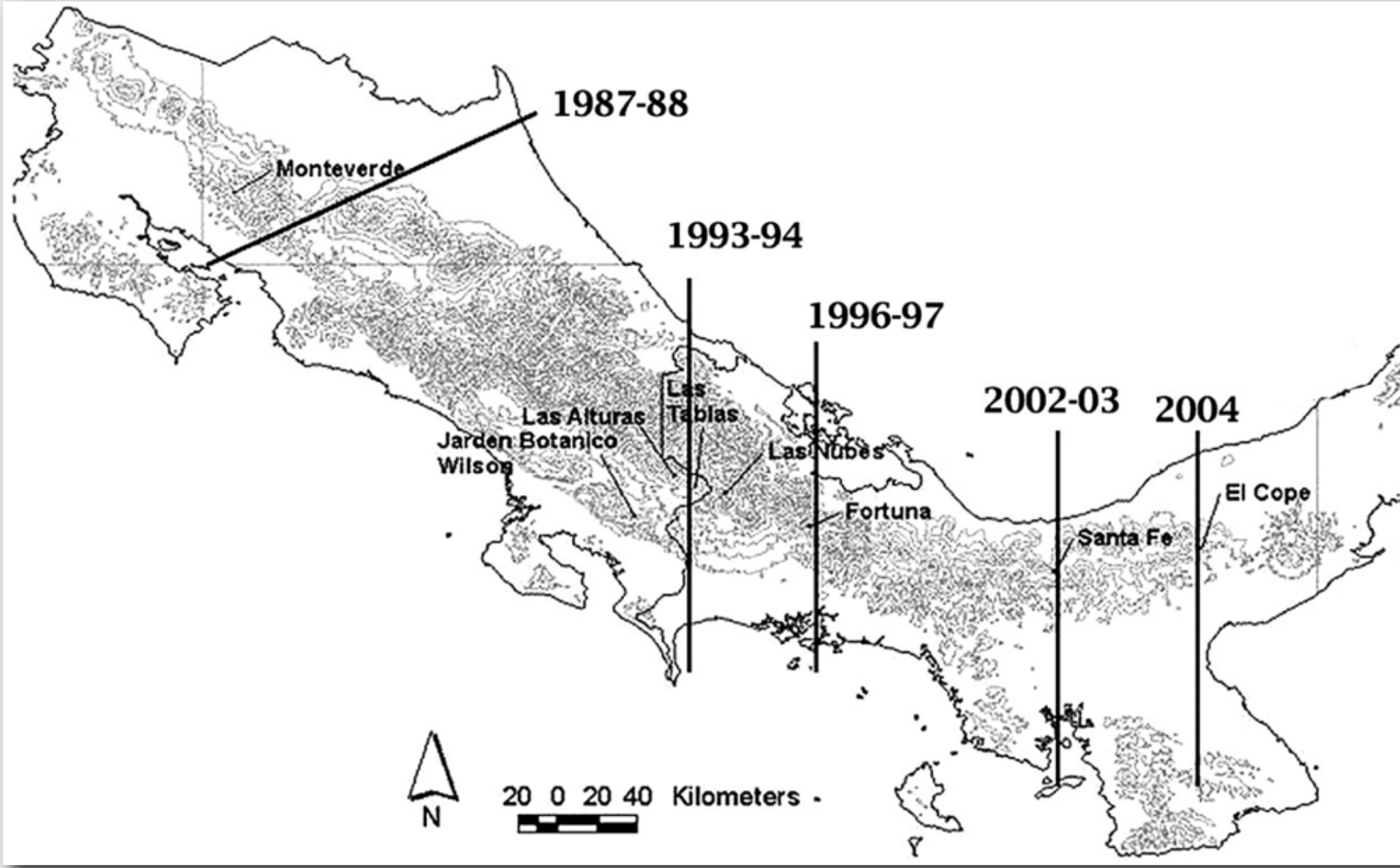
Fig. 1. Summary of the numbers of megafaunal genera that went extinct on each continent (Table 1), the strength of the extinction chronology, and a comparison of the timing of extinction with the timing of human arrival and late Pleistocene climatic change. Extinction timing for individual genera was judged as robust or provisional based on previous publications that evaluated quality of dates. Sources are as follows: Europe (*3*, *14*, *47*), Siberia (*48*), North America (*11*, *29*, *46*, *57*), and Australia (*4*, *7*). For humans, the date is the earliest generally accepted arrival of *Homo sapiens sapiens*; pre-*sapiens* hominins were present in Eurasia and Africa much earlier.

Barnosky et al. Assessing the causes of Late Pleistocene extinctions on the continents. Science (2004) vol. 306 (5693) pp. 70-75



Fossil range scaled to time. Faunal change appears gradual except around 251.4 Ma. The positions of volcanic ash beds and isotopic ages are from (3). The carbon-13 profiles integrate all available data from the Meishan sections (8, 20, 21). Three previously proposed extinction levels are shown (indicated by A, B, and C)

Jin et al. Pattern of marine mass extinction near the Permian-Triassic boundary in South China. Science (2000) vol. 289 (5478) pp. 432-436



Lips et al. 2006. Emerging infectious disease and the loss of biodiversity in a Neotropical amphibian community. PNAS 103(9_: 3165-3170

Disclaimer: This information is preliminary or provisional and is subject to revision. It is being provided to meet the need for timely best science. The information has not received final approval by the U.S. Geological Survey (USGS) and is provided on the condition that neither the USGS nor the U.S. Government shall be held liable for any damages resulting from the authorized or unauthorized use of the information.

0 250 500 KILOMETERS

0 250 500 MILES

Map Created: 8/30/2019

White-Nose Syndrome
Occurrence by County/District
(or portions thereof)

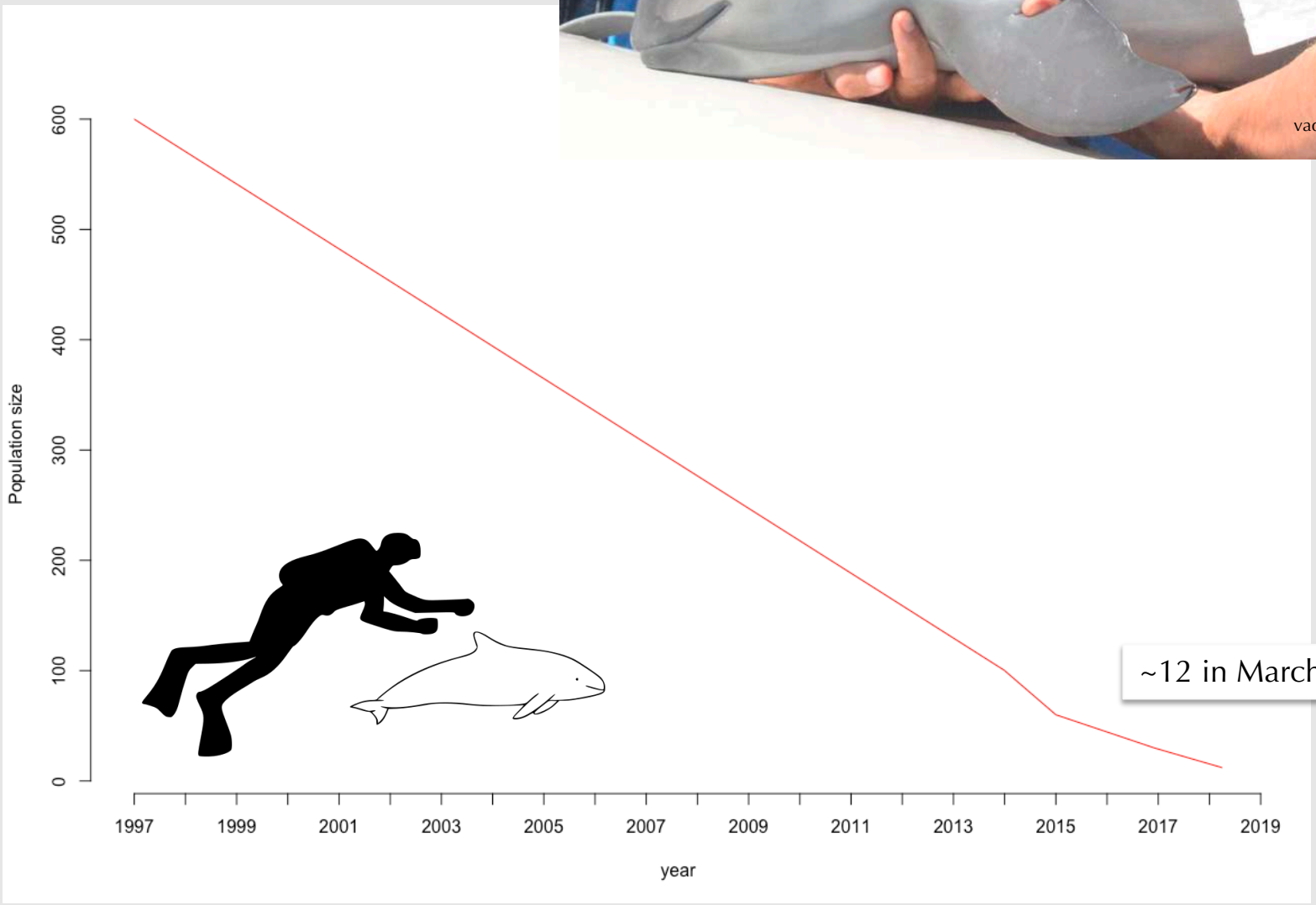
Bat hibernation period
Fall-Winter-Spring

- 2006-07
- 2007-08
- 2008-09
- 2009-10
- 2010-11
- 2011-12
- 2012-13
- 2013-14
- 2014-15
- 2015-16
- 2016-17
- 2017-18
- 2018-19

First detected 2/2006
Confirmed: Solid color
Suspect: Solid color with dots

Citation: White-nose syndrome occurrence map - by year (2019). Data Last Updated: 8/30/2019. Available at: https://www.whitenosesyndrome.org/static-page/wns-spread-maps.

http://www.nwhc.usgs.gov/disease_information/white-nose_syndrome/gallery.jsp



~12 in March, 2018

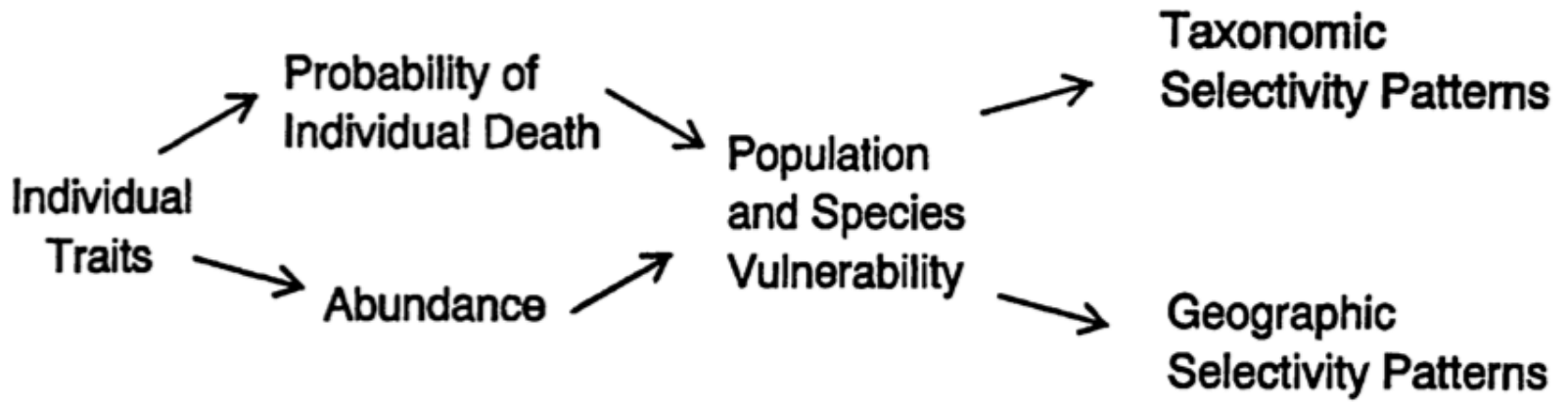


Figure 1 Individual traits influence extinction by their effect on the probability of individual death and on abundance. This translates into population and then species vulnerability. Phylogenetic nesting of species vulnerability among taxa from evolutionary constraints results in nonrandom taxonomic and geographic patterns of selectivity.

McKinney. Extinction vulnerability and selectivity: combining ecological and paleontological views. Annual Review of Ecology and Systematics (1997) vol. 28 (1) pp. 495-516

Table 1 Biological traits cited in the ecological and paleontological literature as increasing extinction risk. Symbols: ++ = many citations identified, + = at least one citation identified, − = none identified so far. Citations for modern extinctions are 5, 10, 20, 21, 29, 30, 45, 61, 62, 78, 80, 84, 92, 102, 108. Citations for fossil extinctions are 2, 8, 22, 29, 48, 49, 51, 66, 72, 75, 86, 89, 95, 99, 100, 105

	Modern extinctions	Fossil extinctions
Individual Traits		
Specialization:	++	++
* Stenothermy	++	++
* Specialized diet	++	++
* High trophic level	++	++
* Symbiotic	++	+
* Large body size	++	++
* Low fecundity	++	+
* Long-lived	++	+
* Slow growth/development	++	+
* Complex morphology	+	++
* Complex behavior	+	+
* Limited mobility	++	−
* Migratory	++	−
Aquatic biotas:		
* Planktic	+	++
* Epifaunal	+	++
* Filter-feeder	+	++
- Coarse-filter feeder	−	+
* Non-benthic larvae	+	+
* Non-brooding larvae	−	+
Abundance Traits		
Low mean abundance (K):	++	++
* localized range	++	++
* low density	++	++
High abundance variation	++	+
Low intrinsic growth (r)	++	−
Seasonal aggregations	++	−
Low genetic variation	++	−
Aquatic biotas:		
* Small colonies (corals)	−	+

McKinney. Extinction vulnerability and selectivity: combining ecological and paleontological views. Annual Review of Ecology and Systematics (1997) vol. 28 (1) pp. 495-516

McKinney and Lockwood. Biotic homogenization: a few winners replacing many losers in the next mass extinction. Trends Ecol Evol (1999) vol. 14 (11) pp. 450-453

Table 2. Taxonomic patterns among local and global winners and losers

Group[a]	Over-represented families	Biasing traits[c]	Refs
Losers (global)			
Threatened birds[b]	Parrot, pheasant	Large size, low fecundity	20
Threatened mammals[b]	Ape, rhinoceros	Large size, low fecundity	12
Threatened plants	Cactus	Small range	38
Losers (local)			
Birds (Sumatran forest)	Babbler	Large, forest specialist	27
Birds (Brazilian forest)	Parrot	Large, frugivore	21
Birds (USA urban)	Vireo	Migratory, insectivore	37
Frogs (Amazon forest)	Leptodactyl	Inner forest specialist	24
Insects (Boreal forest)	Fungus gnat	Diet (forest)	39
Salamanders (Maine forest, USA)	Plethodontid	Skin respiration	31
Plants (Singapore forest)	Rubiacid (shrub)	Shade-tolerant	35
Winners (global)			
Invasive plants[b]	Grass, roses	Rapid growth, ornamental	22
Serious weeds[b]	Grass, pondweed	Rapid dispersal/growth	17
Widespread weeds[b]	Grass, cattail	Rapid dispersal/growth	17
Natural area plant invaders[b]	Grass, legume	Broadly tolerant	17
Introduced birds[b]	Duck, pheasant	Good for sport/pets	11
Domesticated mammals	Bovids	Non-territorial, broad diet	40
Winners (local)			
Birds (agroforestry)	Warbler	Small, omnivore/granivore	27
Moths (Borneo forest)	Sphingid	Open-habitat, generalist	34
Frogs (Amazon forest)	Hylids	Temporary pond breeder	24
Spiders (S. African forest)	Wolf spider	Plant-independent webs	25

[a]Habitats are given in parentheses.

[b]Groups were analyzed statistically to document non-random concentrations of loser or winner species within families.

[c]Reported traits that are common in a family and apparently promote the geographic spread or decrease of many species in the family.

McKinney and Lockwood. Biotic homogenization: a few winners replacing many losers in the next mass extinction. Trends Ecol Evol (1999) vol. 14 (11) pp. 450-453

Table 3. Traits influencing whether species are winners or losers in a human-dominated world[a]

Traits promoting range expansion	Traits promoting extinction
r-selected traits (small size, high fecundity)	*K*-selected traits (large size, low fecundity)
High variability	Low variability
Widespread	Rare
Rapid dispersal	Slow dispersal
Generalist (eurytopy)	Specialist (stenotopy)
Human commensalism	Poorly adapted to human activities

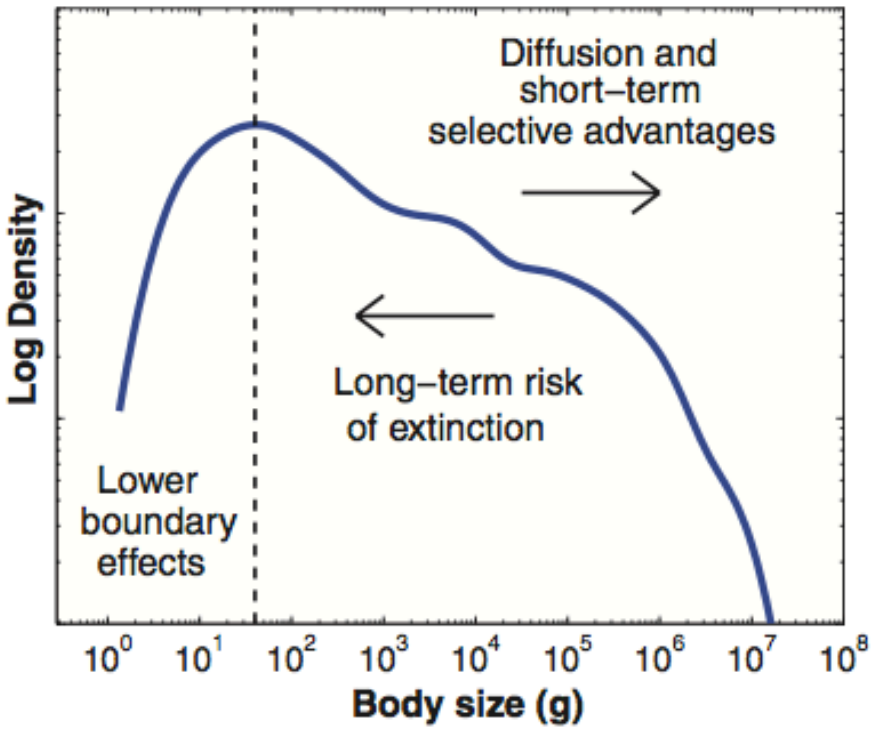


Fig. 1. Smoothed species body-size distribution of 4002 Recent terrestrial mammals [data from (*21*)], showing the three macroevolutionary processes that shape the relative abundances of different sizes. The left tail of the distribution is created by diffusion in the vicinity of a taxon-specific lower limit near 2 g, whereas the long right tail is produced by the interaction of diffusion over evolutionary time (including trends like Cope's rule) and the long-term risk of extinction from increased body size.

Clauset and Erwin. The evolution and distribution of species body size. Science (2008) vol. 321 (5887) pp. 399

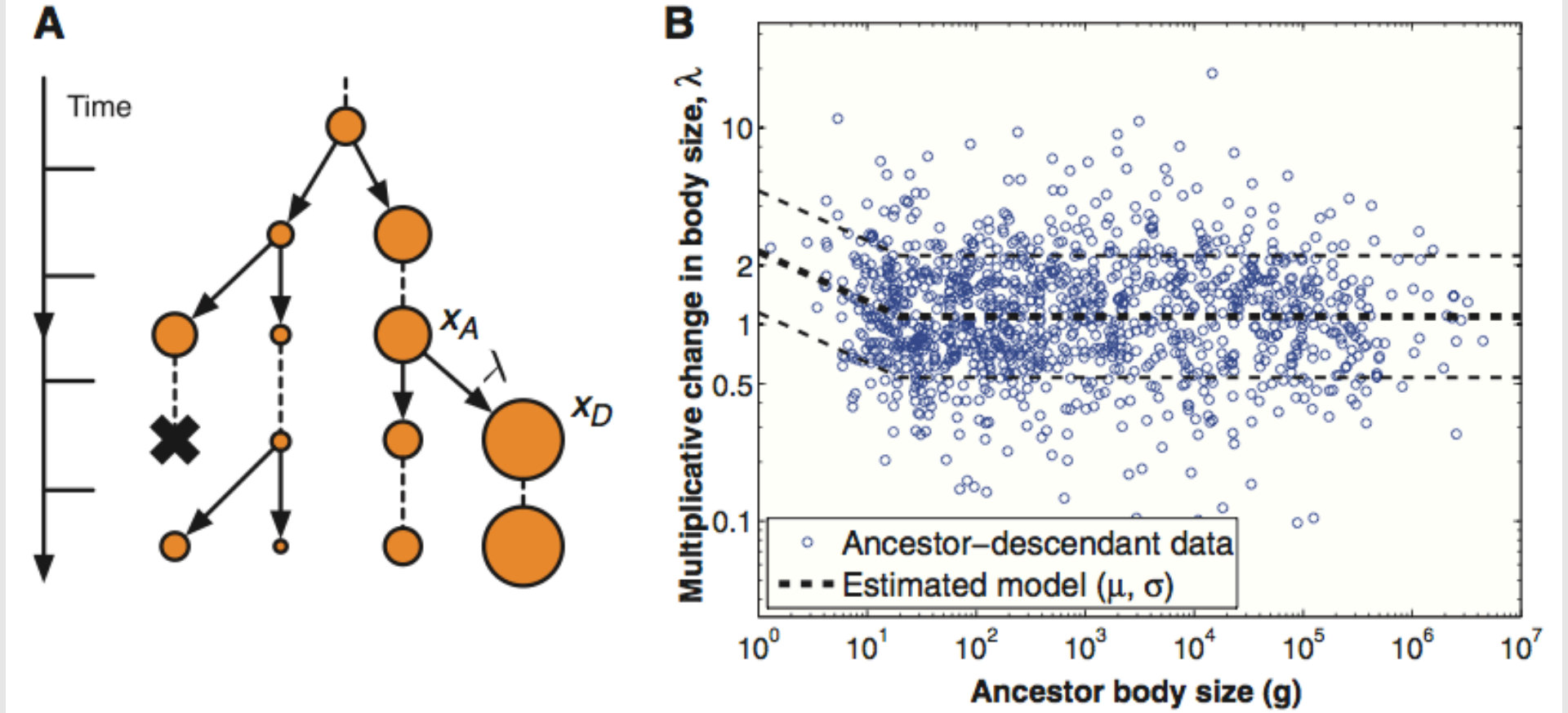
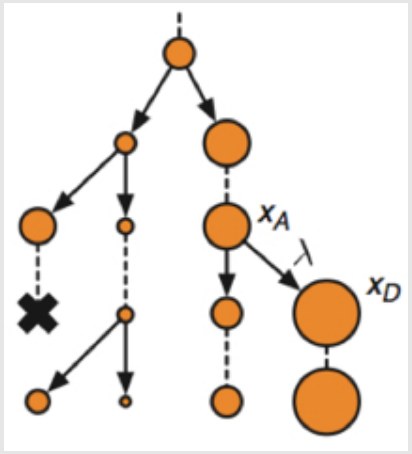


Fig. 2. (**A**) A schematic illustrating a simple cladogenetic diffusion model of species body-size evolution, where the size of a descendant species x_D is related to its ancestor's size x_A by a multiplicative factor λ. (**B**) Empirical data on 1106 changes in North American mammalian body size [data from (*20*)], as a function of ancestor size, overlaid with the estimated model of within-lineage changes, where the average log-change ⟨log λ⟩ varies piecewise as a function of body size (*24*).

Clauset and Erwin. The evolution and distribution of species body size. Science (2008) vol. 321 (5887) pp. 399



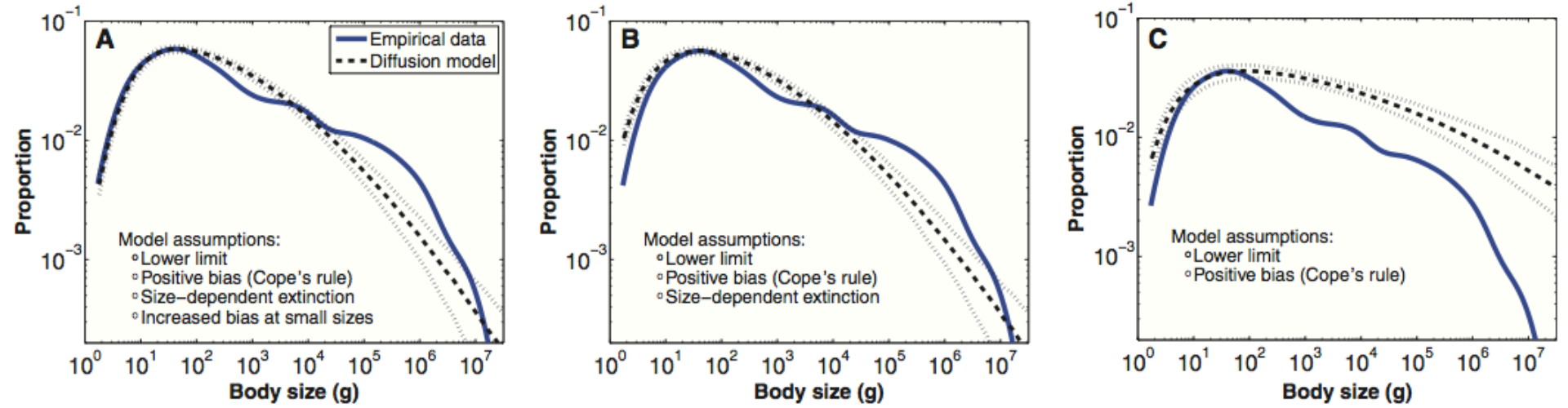
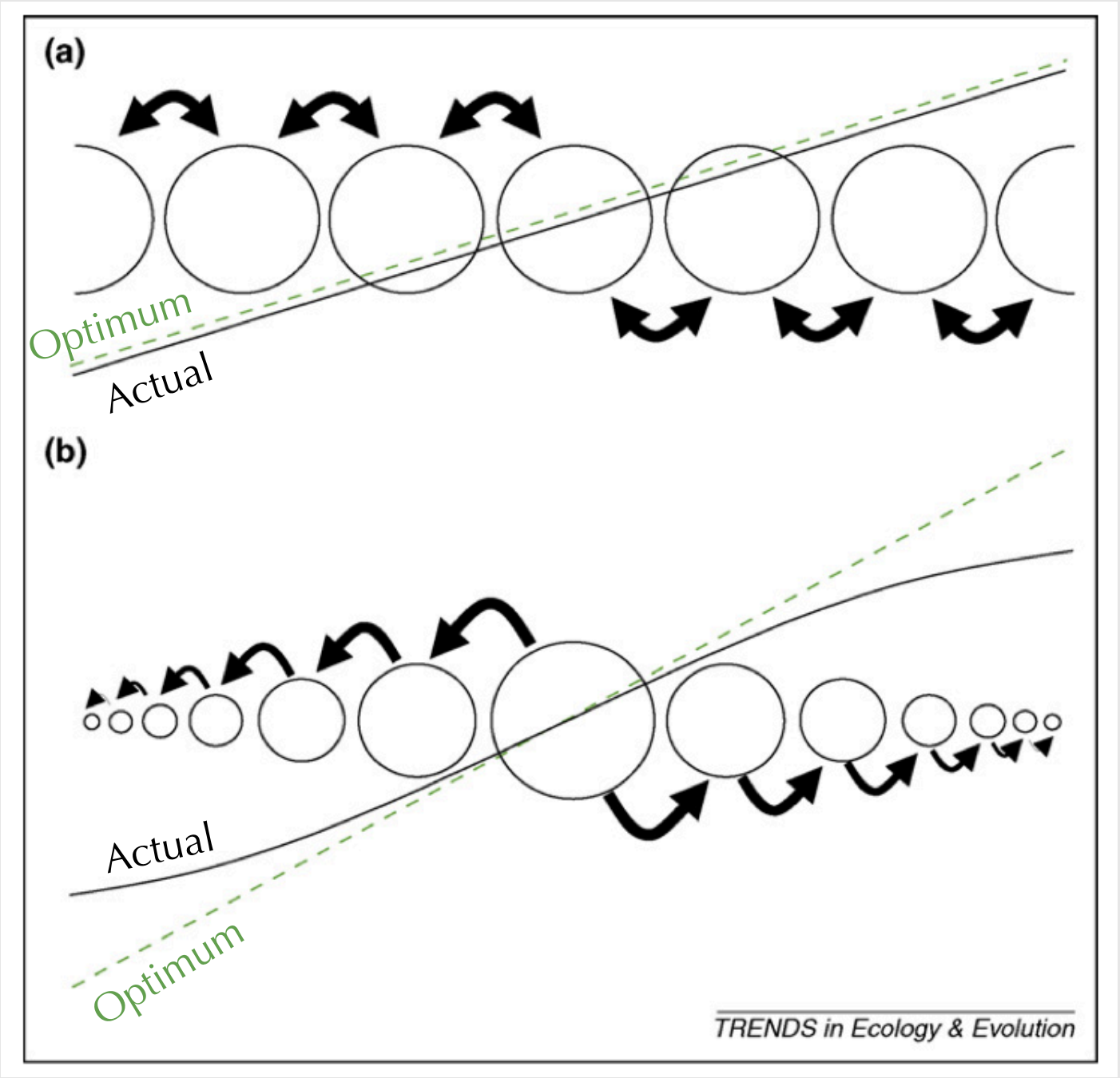


Fig. 3. Simulated distributions of species body size (central tendency ± 95% confidence intervals from 1000 repetitions; all model parameters estimated as described in the text) and the empirical distribution of Recent terrestrial mammals. **(A)** The model described in the text. **(B)** The same model as in (A) but with a bias $\langle \log \lambda \rangle$ that is independent of size. **(C)** The same model as in (B) but with an extinction risk that is independent of size. [For details and additional results, see (*24*).]

Clauset and Erwin. The evolution and distribution of species body size. Science (2008) vol. 321 (5887) pp. 399



Bridle and Vines. Limits to evolution at range margins: when and why does adaptation fail?. Trends Ecol Evol (2007) vol. 22 (3) pp. 140-147