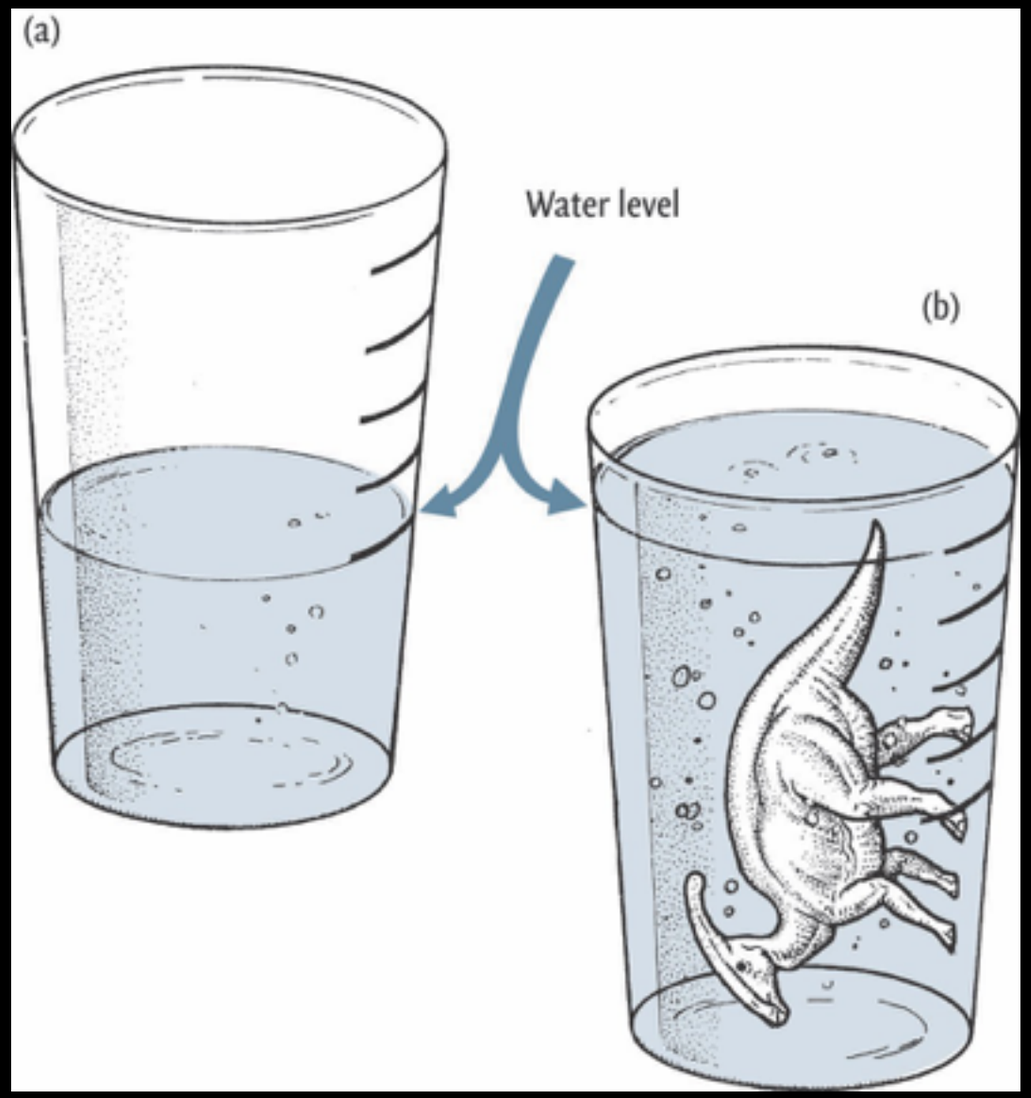
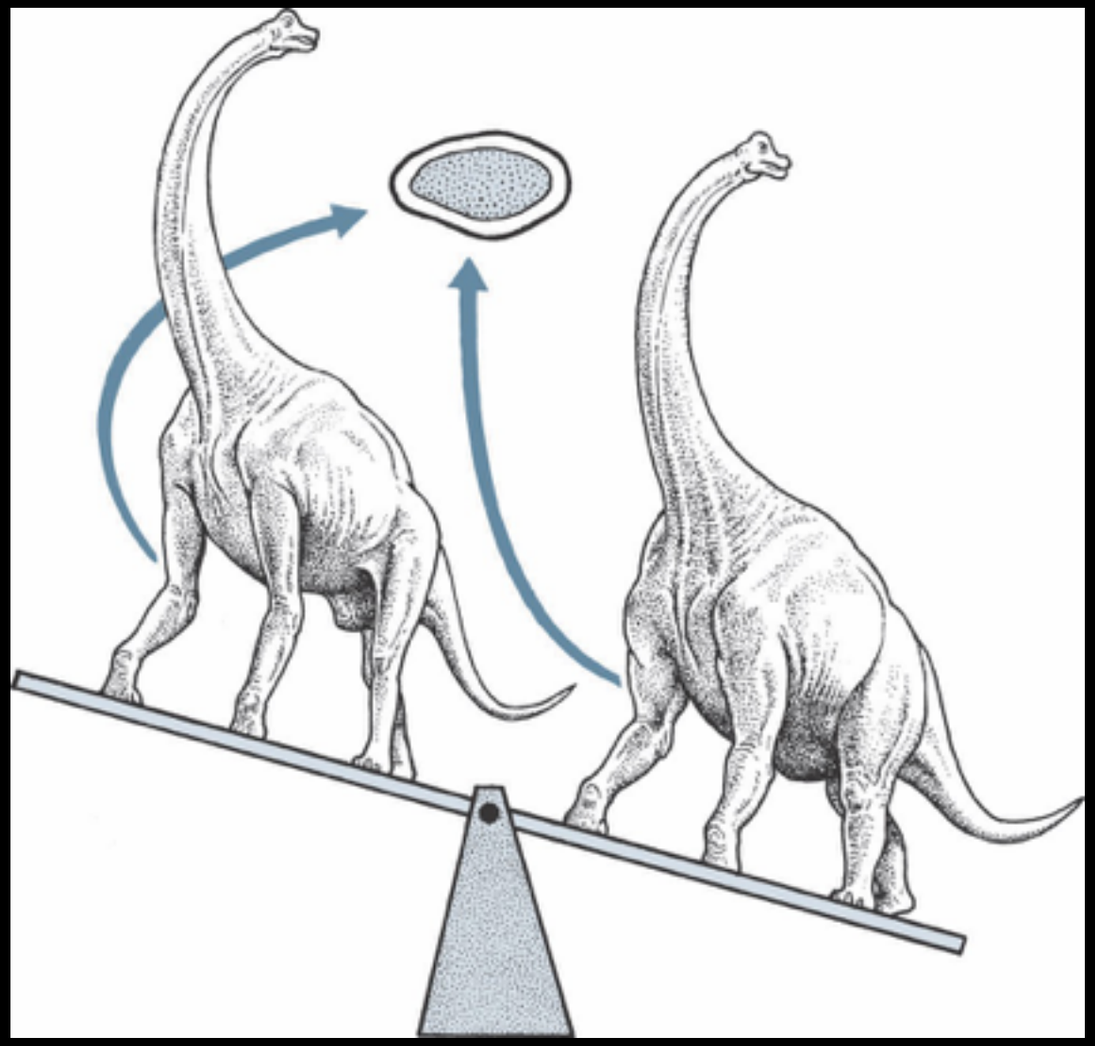
Dinosaurs and Body size

Dinosaurs and Body size

How do we estimate size from fossils?



Volumetric reasoning

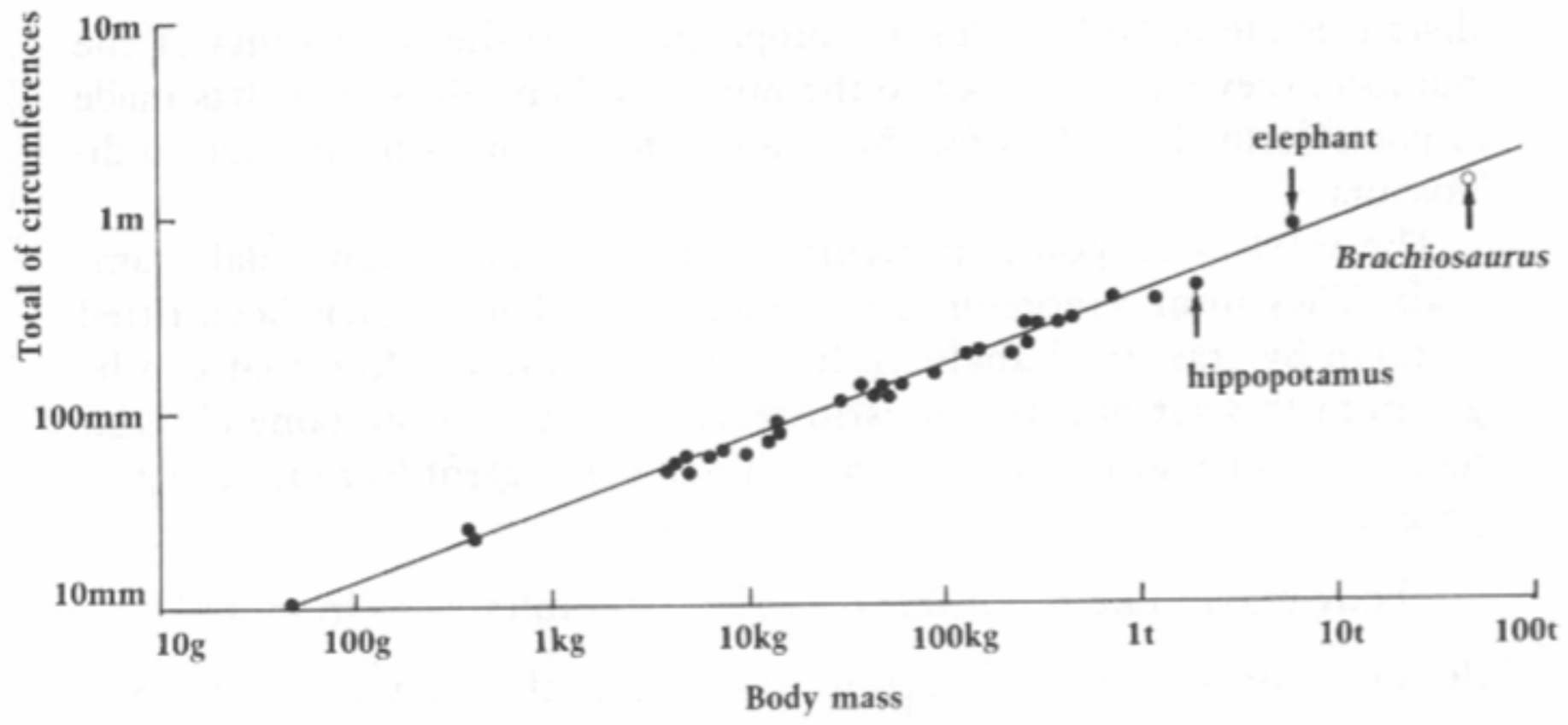


Cross sections of individual bones

Dinosaurs and Body size

How do we estimate size from fossils?

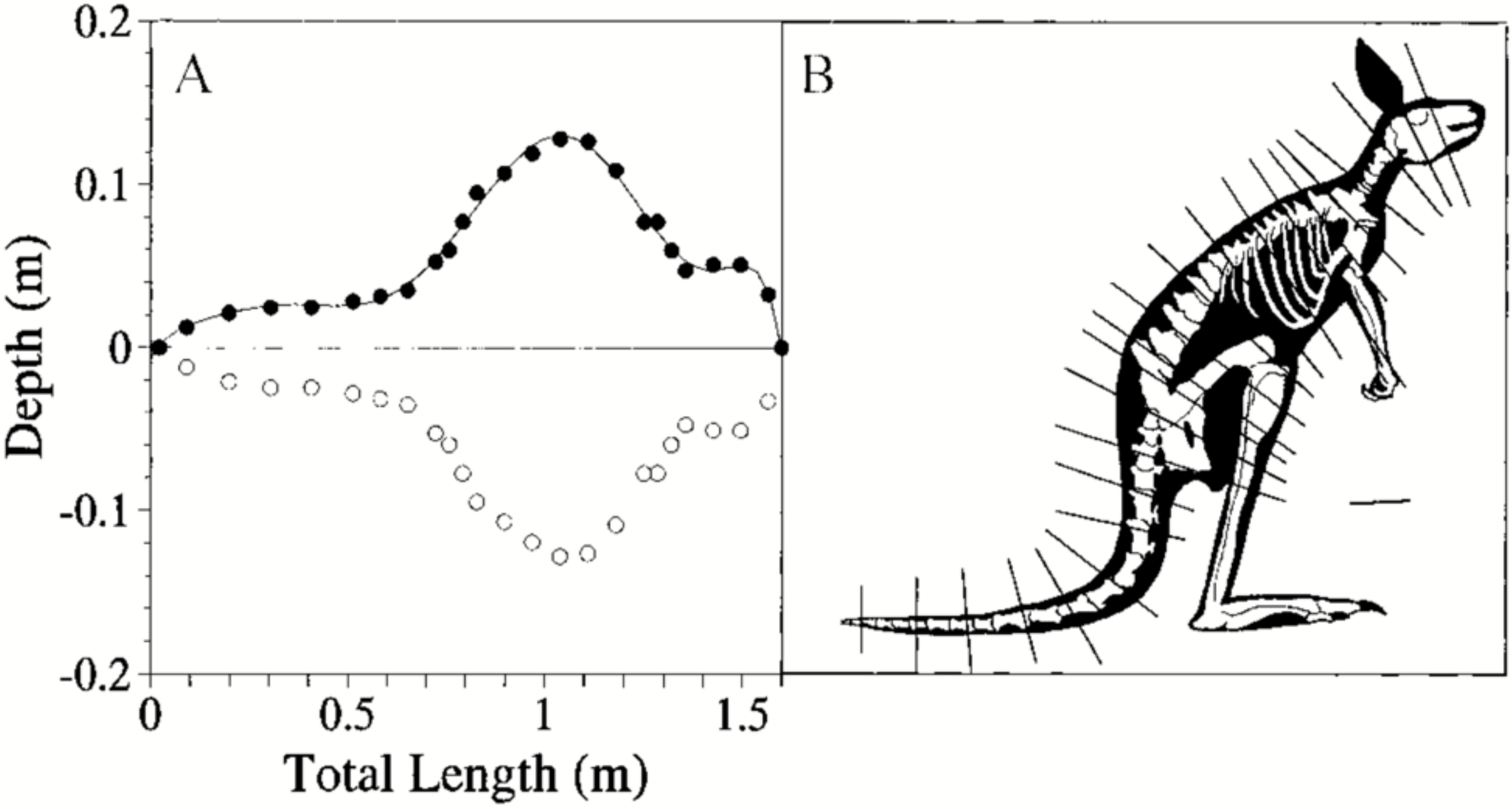
Weighing Dinosaurs with Leg Bone Measurement (cont.)



Log-log plot of data (quadrupedal mammals) obtained by Anderson et al.

Dinosaurs and Body size

How do we estimate size from fossils?



Dinosaurs and Body size

What can body size tell us about the life of the animal?

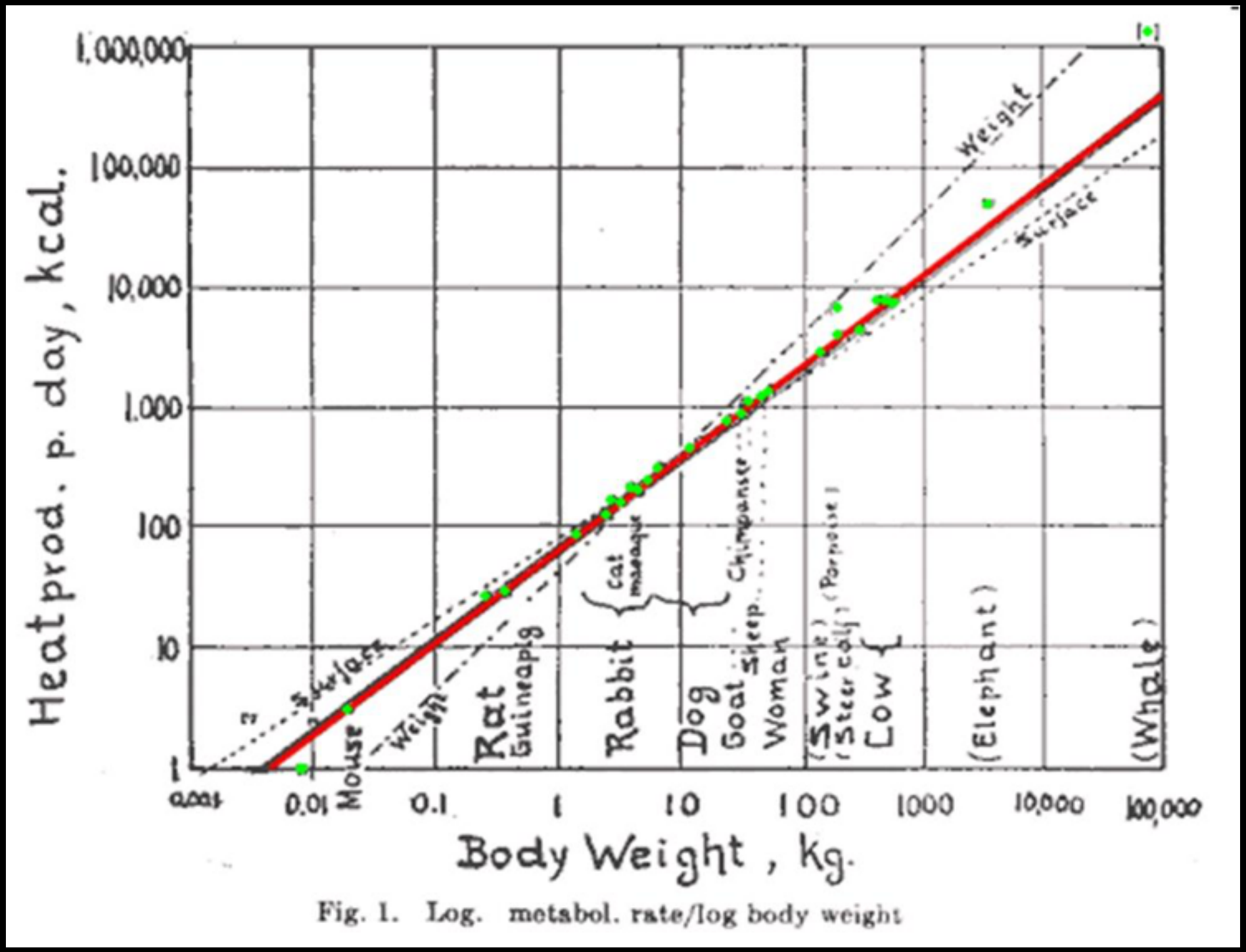
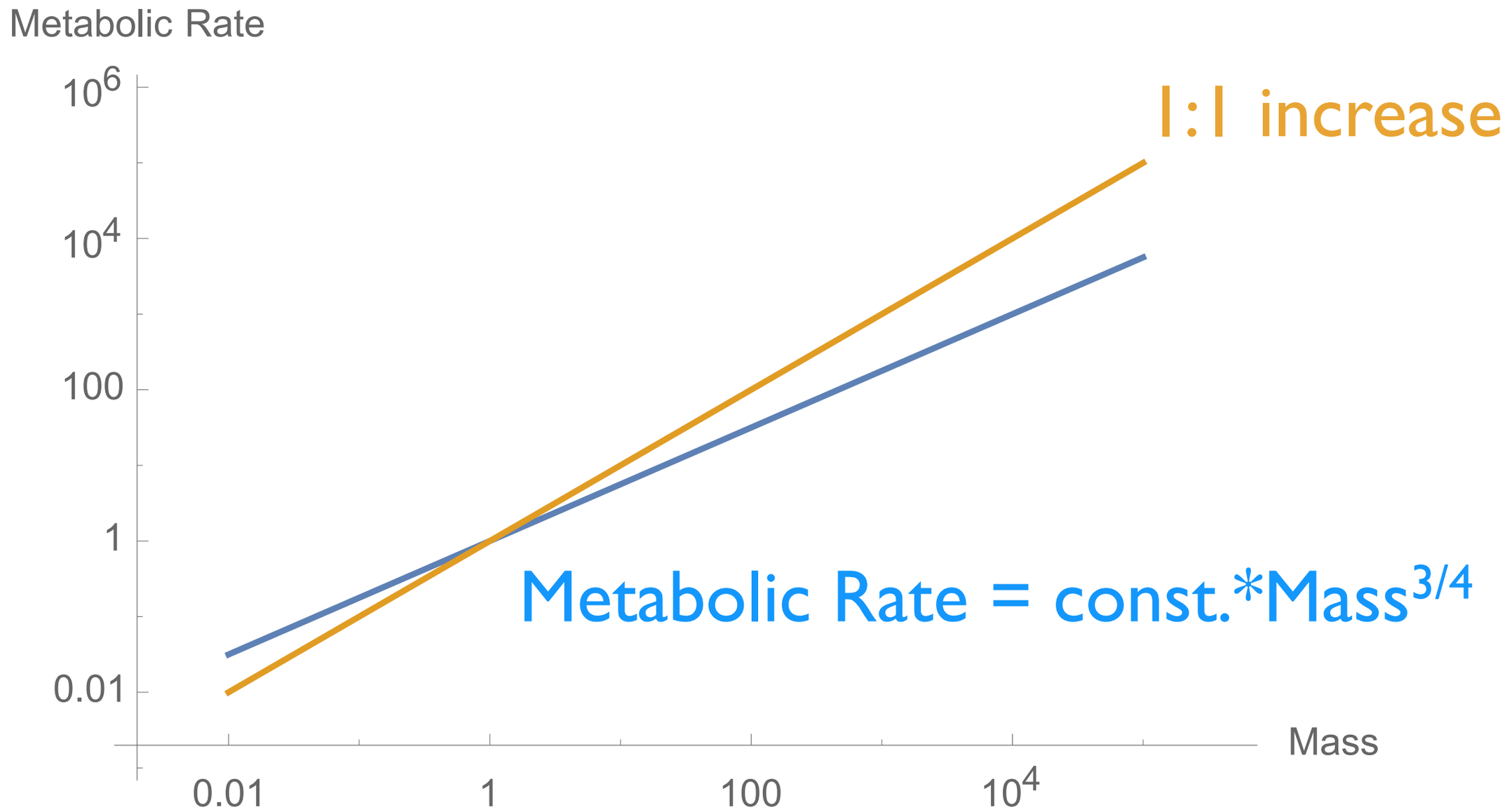


Fig. 1. Log. metabol. rate/log body weight

Metabolic Rate = const.*Mass$^{3/4}$

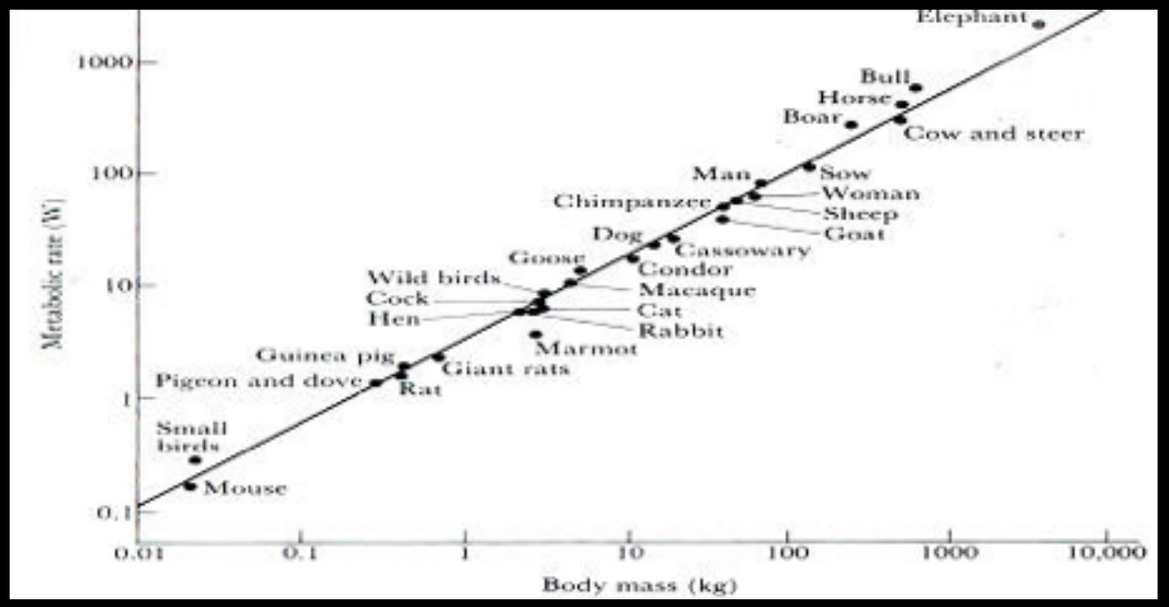
Dinosaurs and Body size

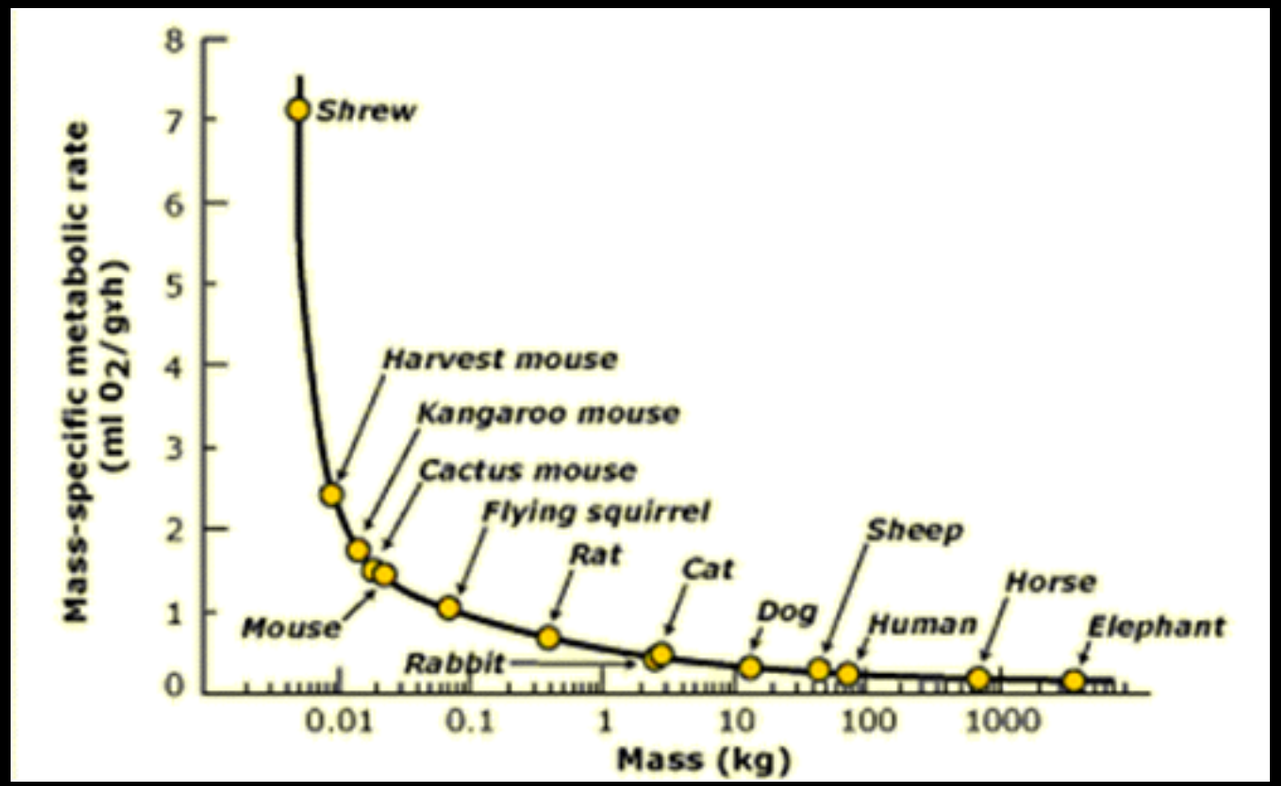
What can body size tell us about the life of the animal?



Dinosaurs and Body size

Metabolism from small to large





Expensive per gram

Cheap per gram

Dinosaurs and Body size

Metabolism from small to large: consequences are in lifestyles

Expensive per gram

Must always be eating
Fast starvation time
Needs high quality food
High reproductive output
Short lifespan

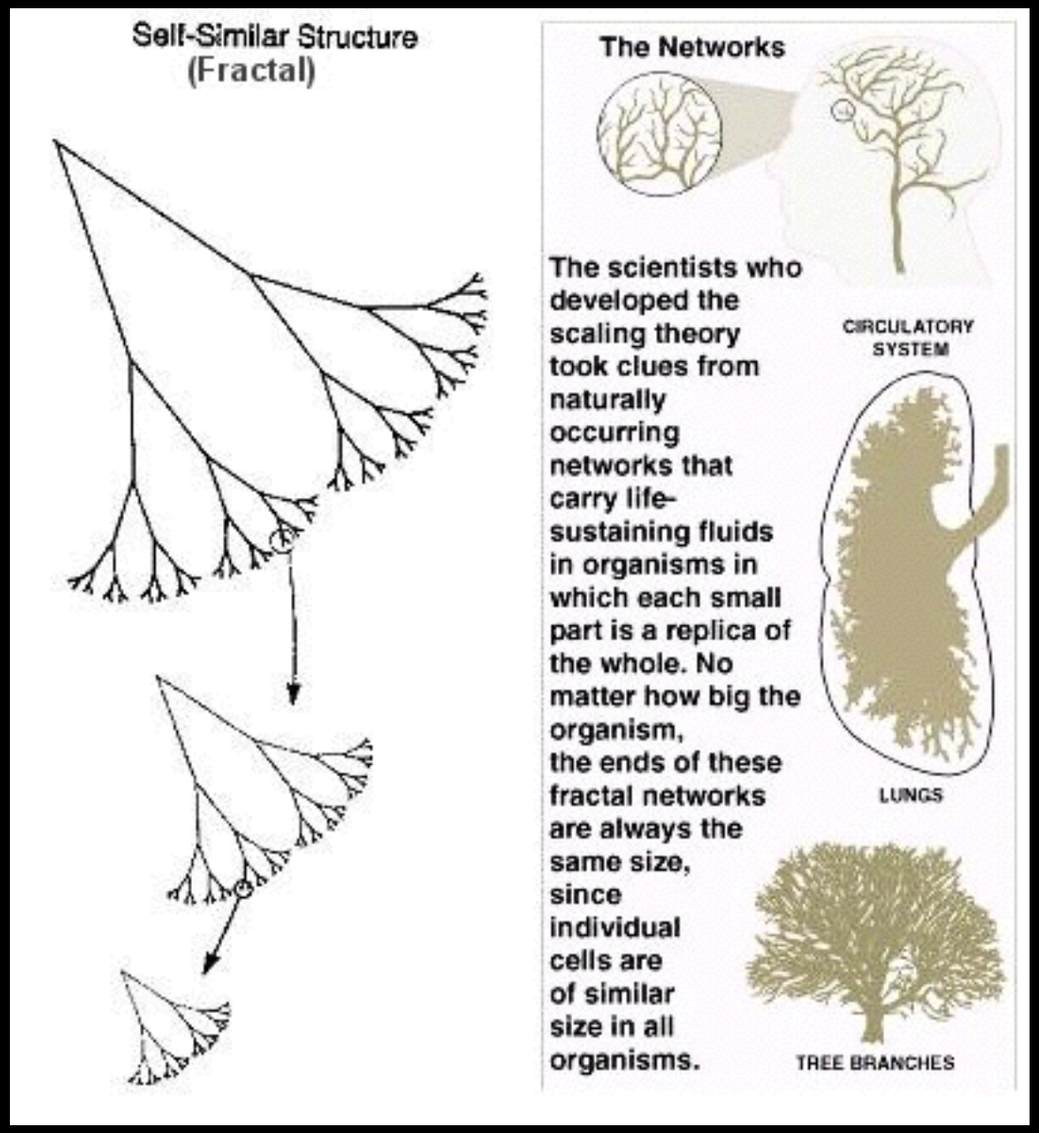
Cheap per gram

Can build reserves (fat)
Slow starvation time
Eats lower quality food
Low reproductive output
Long lifespan

Dinosaurs and Body size

What can body size tell us about the life of the animal?

$$\text{Metabolic Rate} = \text{const.} * \text{Mass}^{3/4}$$



Geoffrey West, Santa Fe Institute

Dinosaurs and Body size

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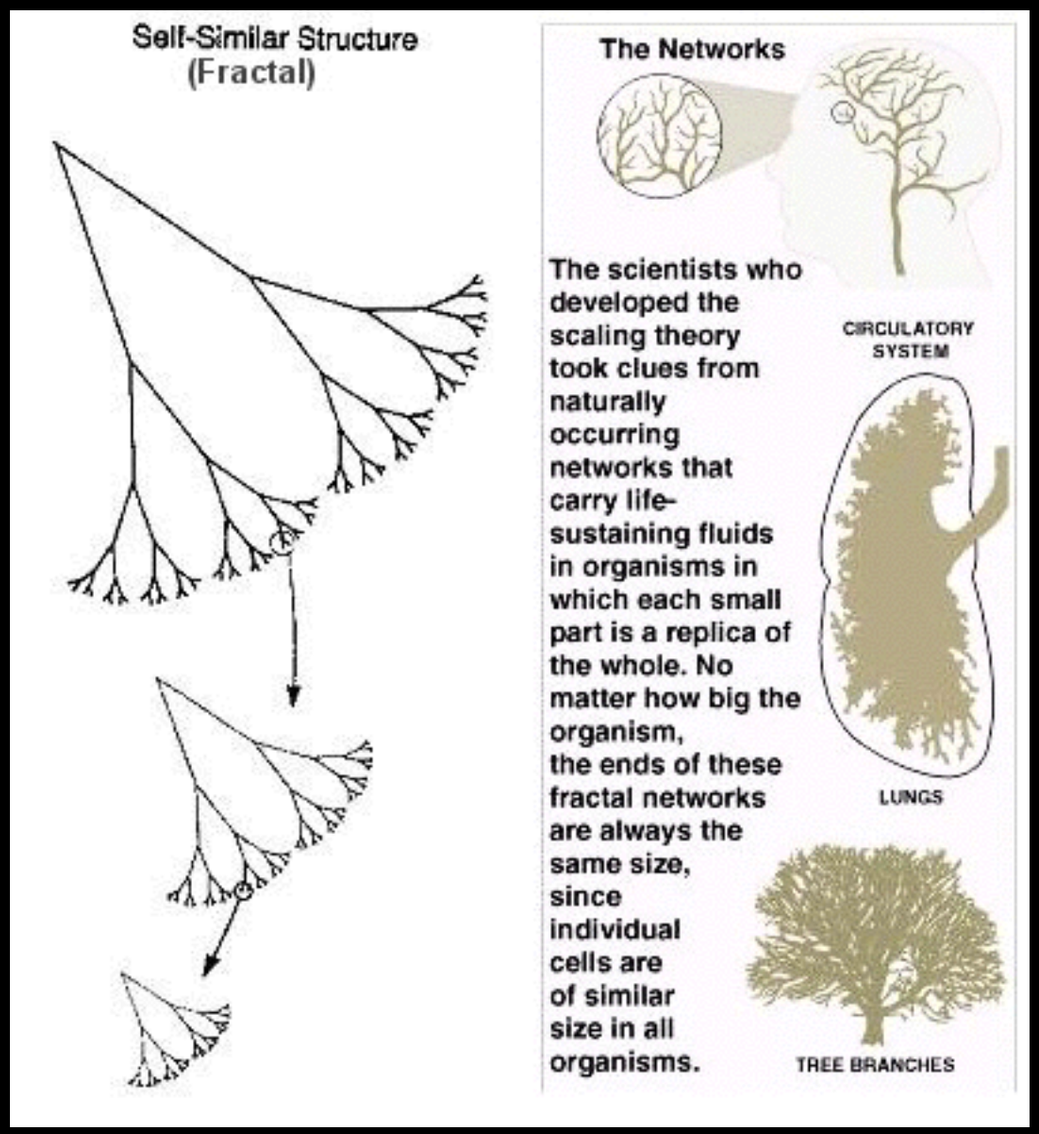
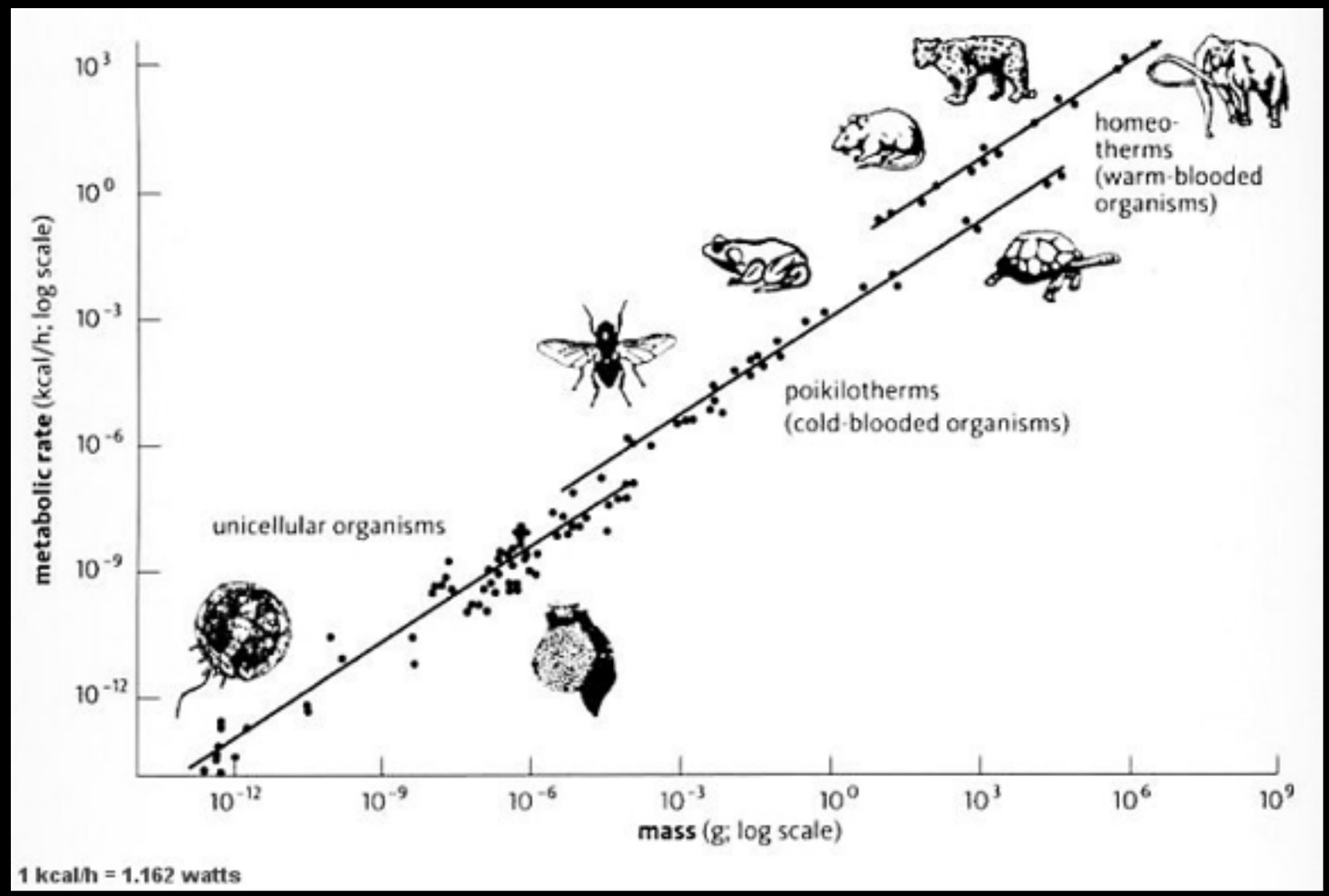
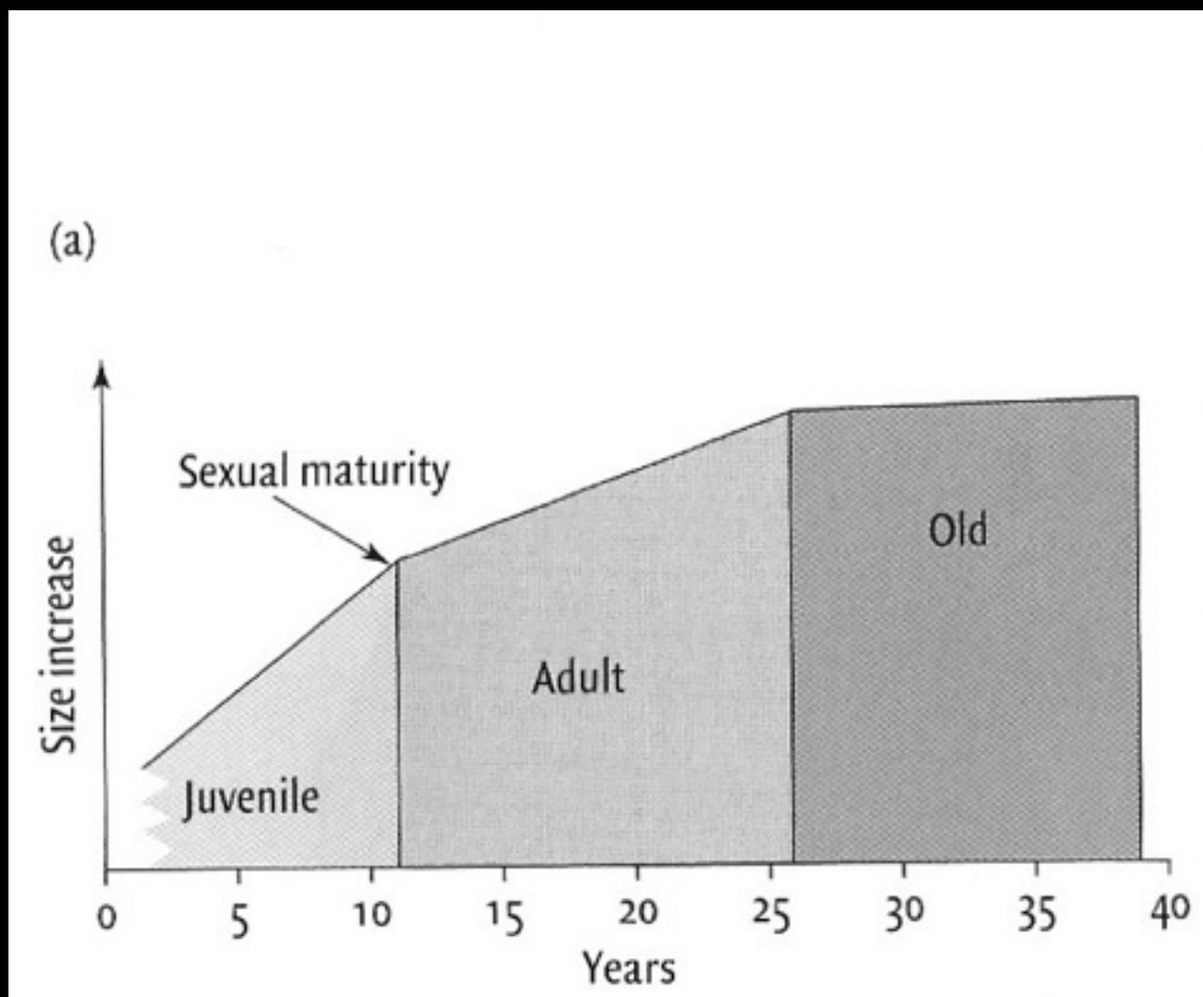
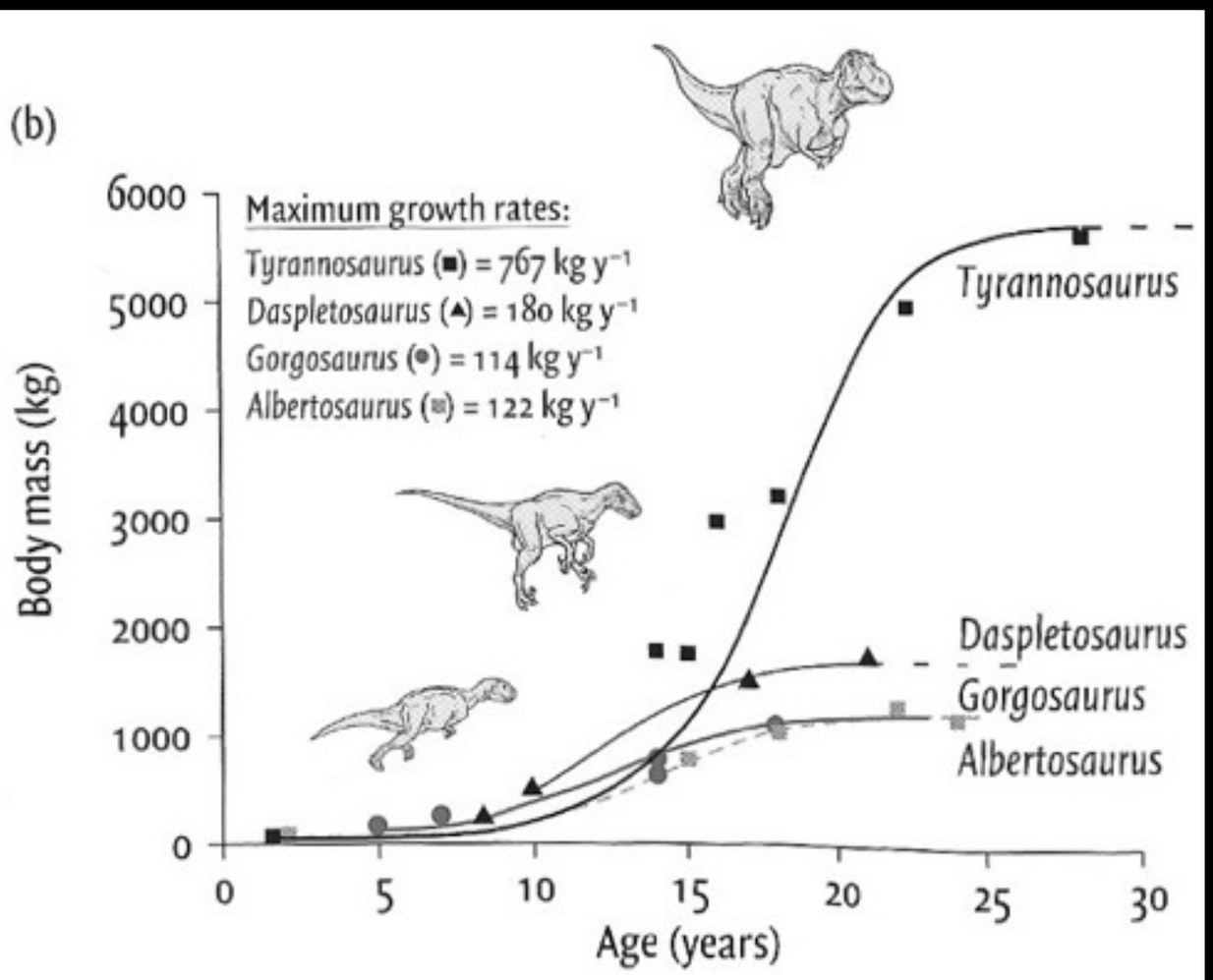




Dinosaurs and Body size

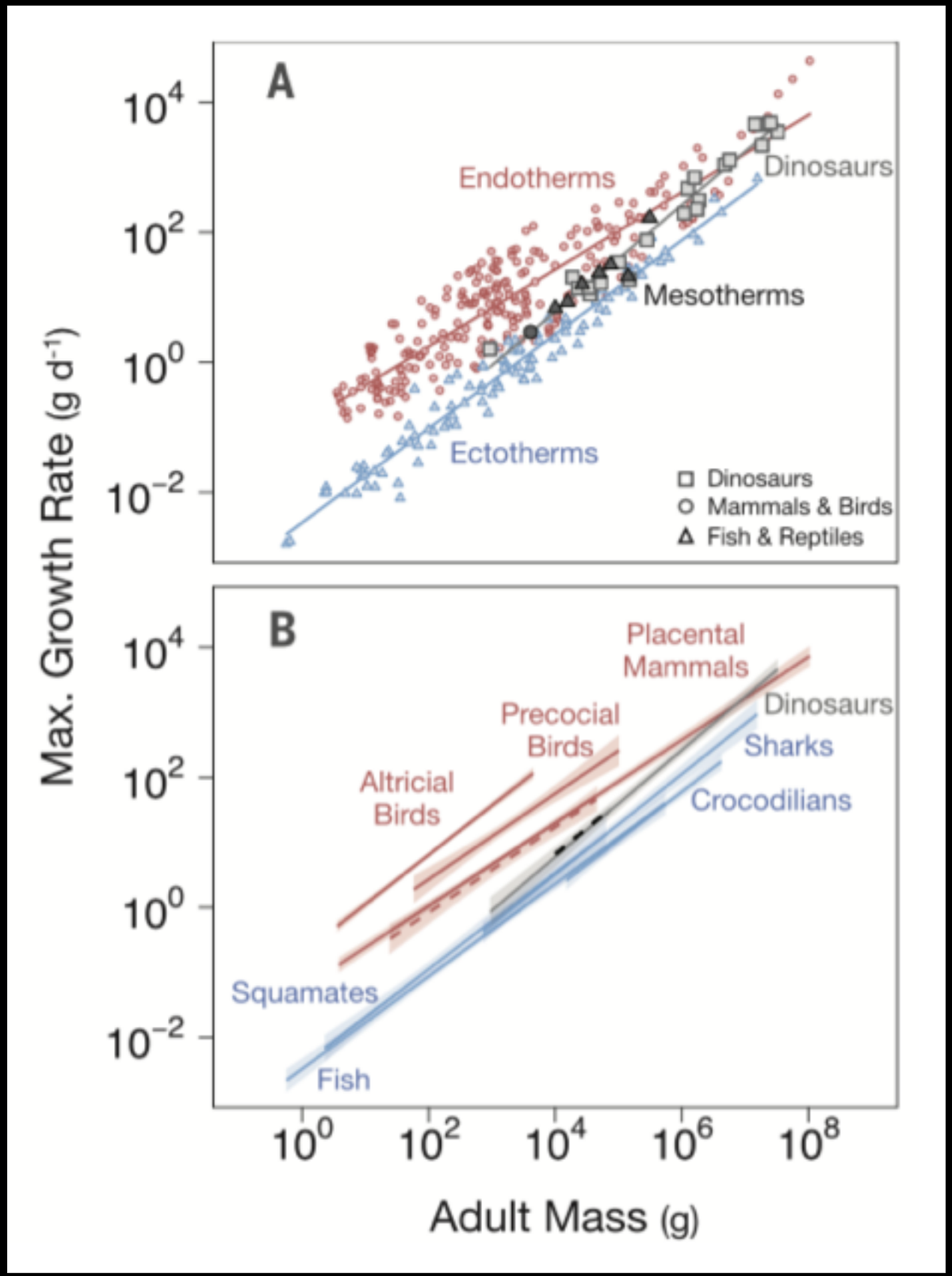
Estimating growth rates from multiple individuals





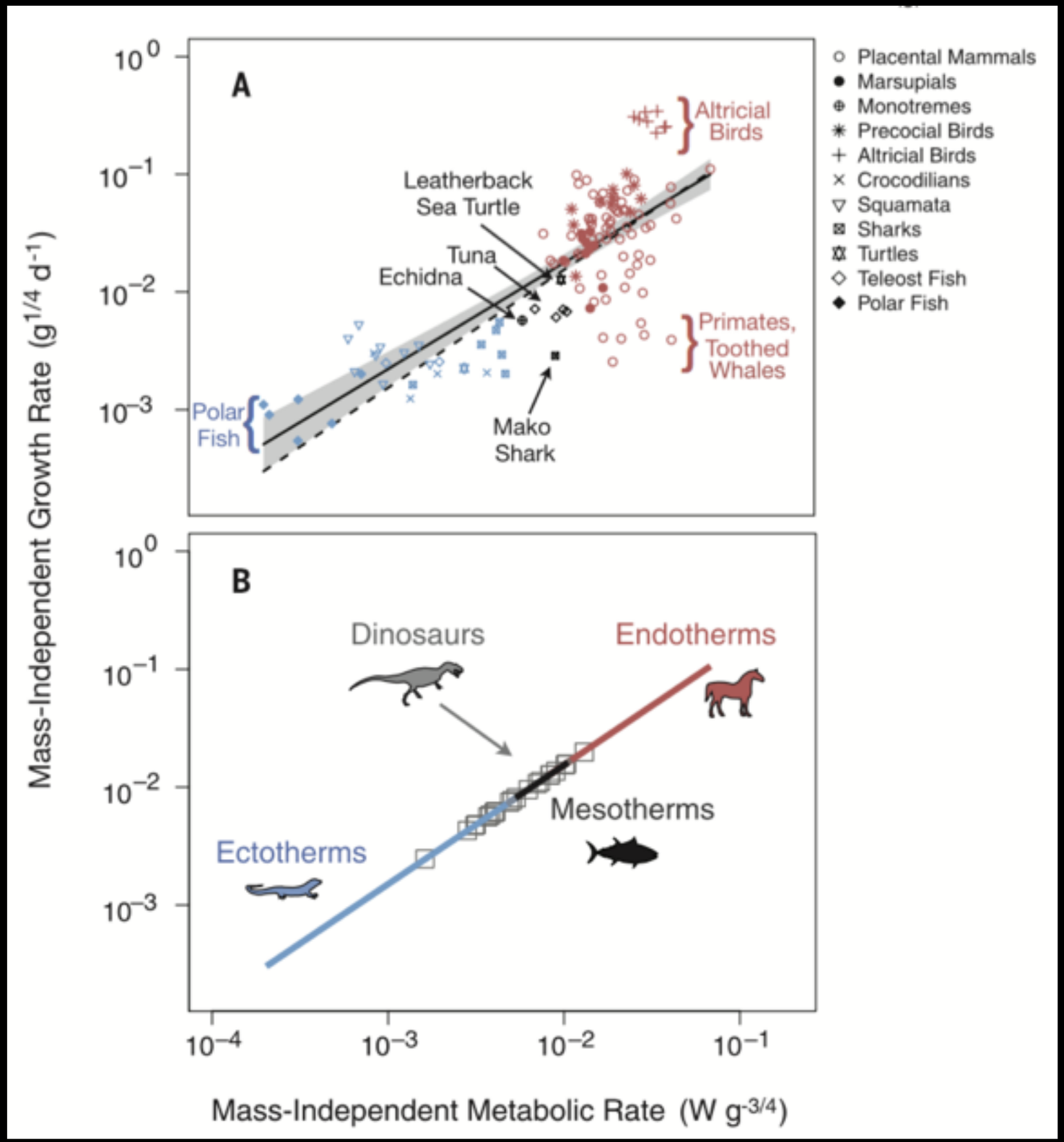
Dinosaurs and Body size

Not ectotherms… not endotherms… *mesotherms*



Dinosaurs and Body size

Not ectotherms… not endotherms… *mesotherms*

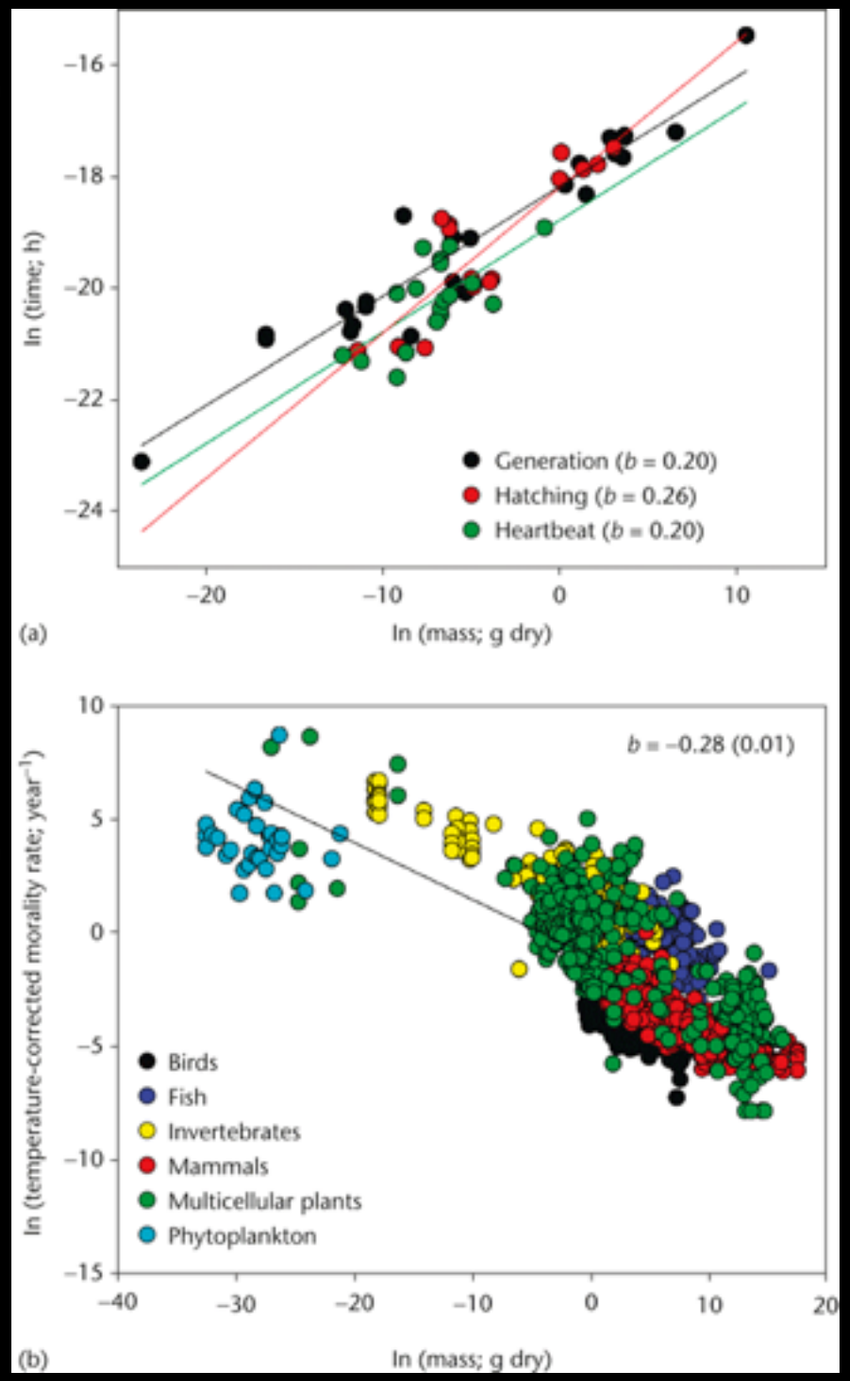


Dinosaurs and Body size

What can body size tell us about the life of the animal?

"Allometric Scaling"

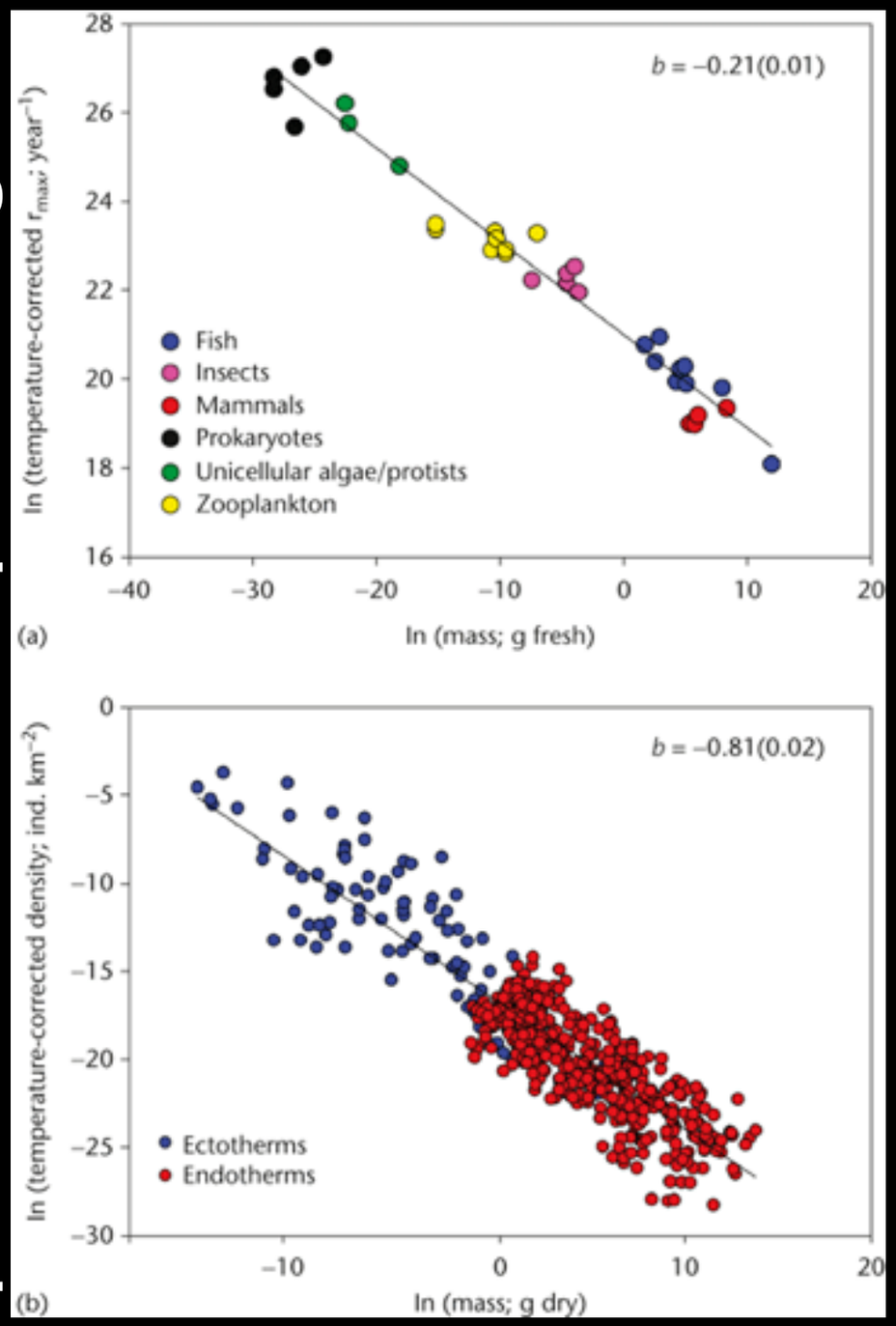
Life history



Mortality

Mass

Population growth



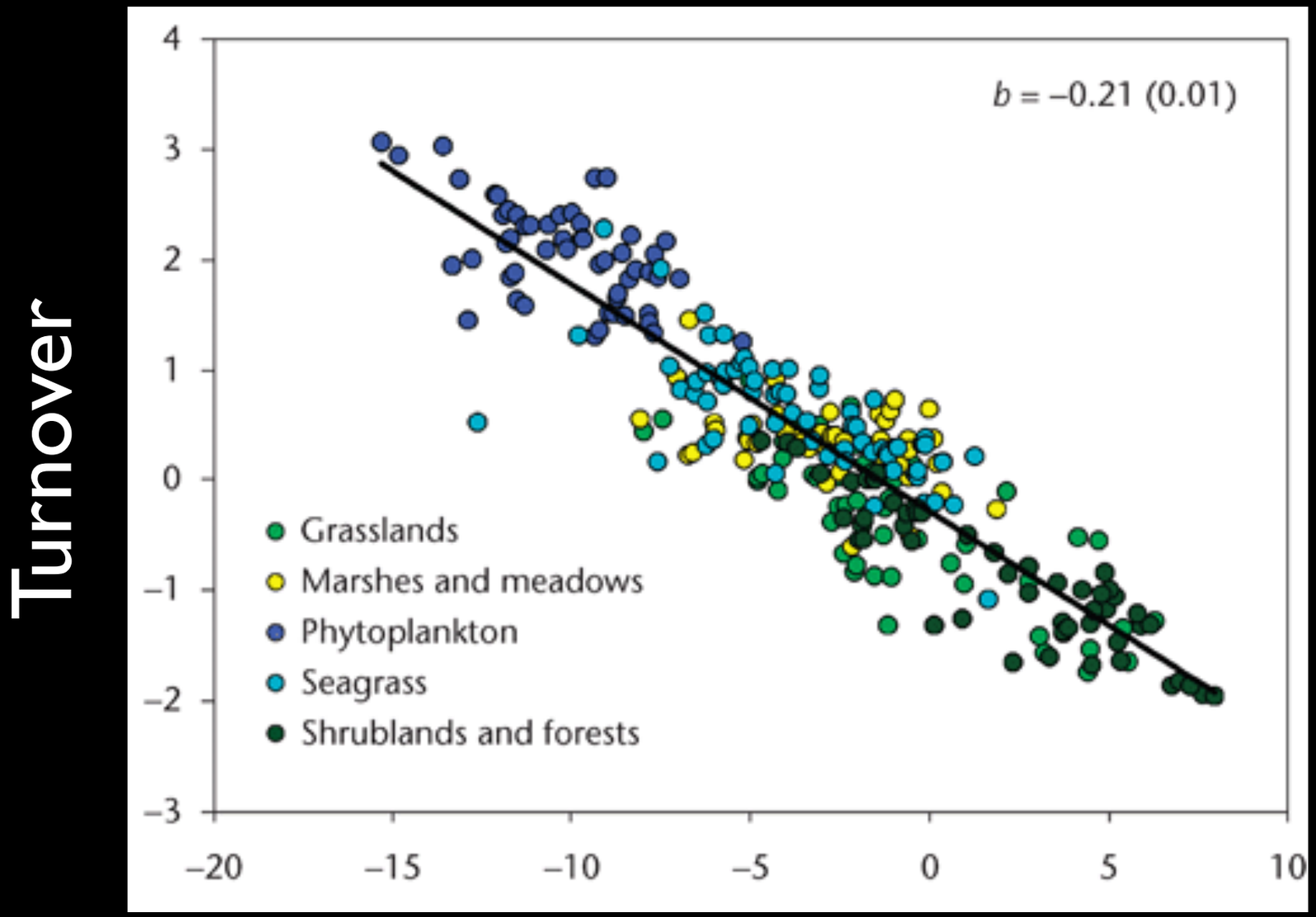
Population size

Mass

Dinosaurs and Body size

What can body size tell us about the life of the animal?

"Allometric Scaling"

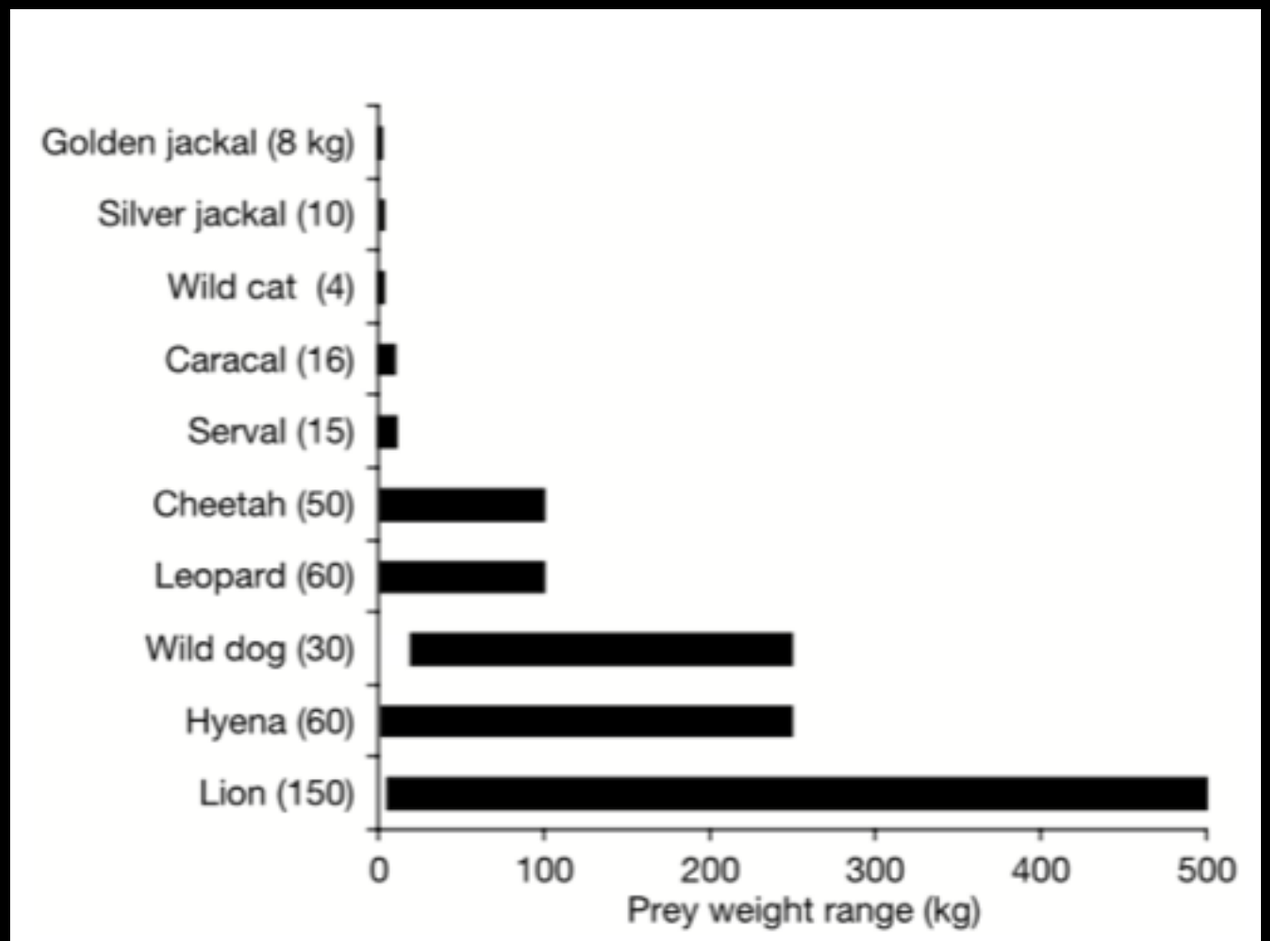


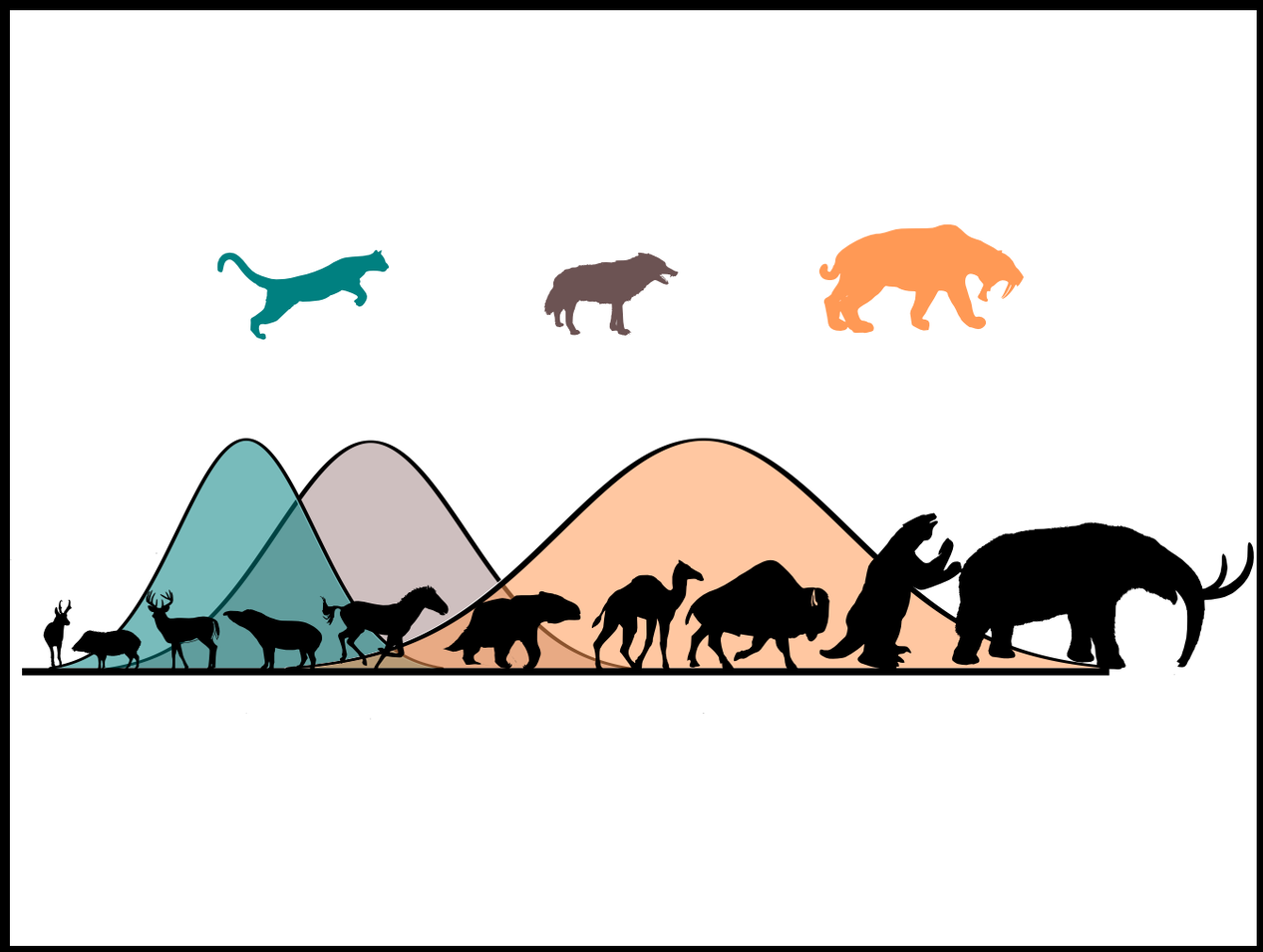
Dinosaurs and Body size

What can body size tell us about the life of the animal?

"Allometric Scaling"

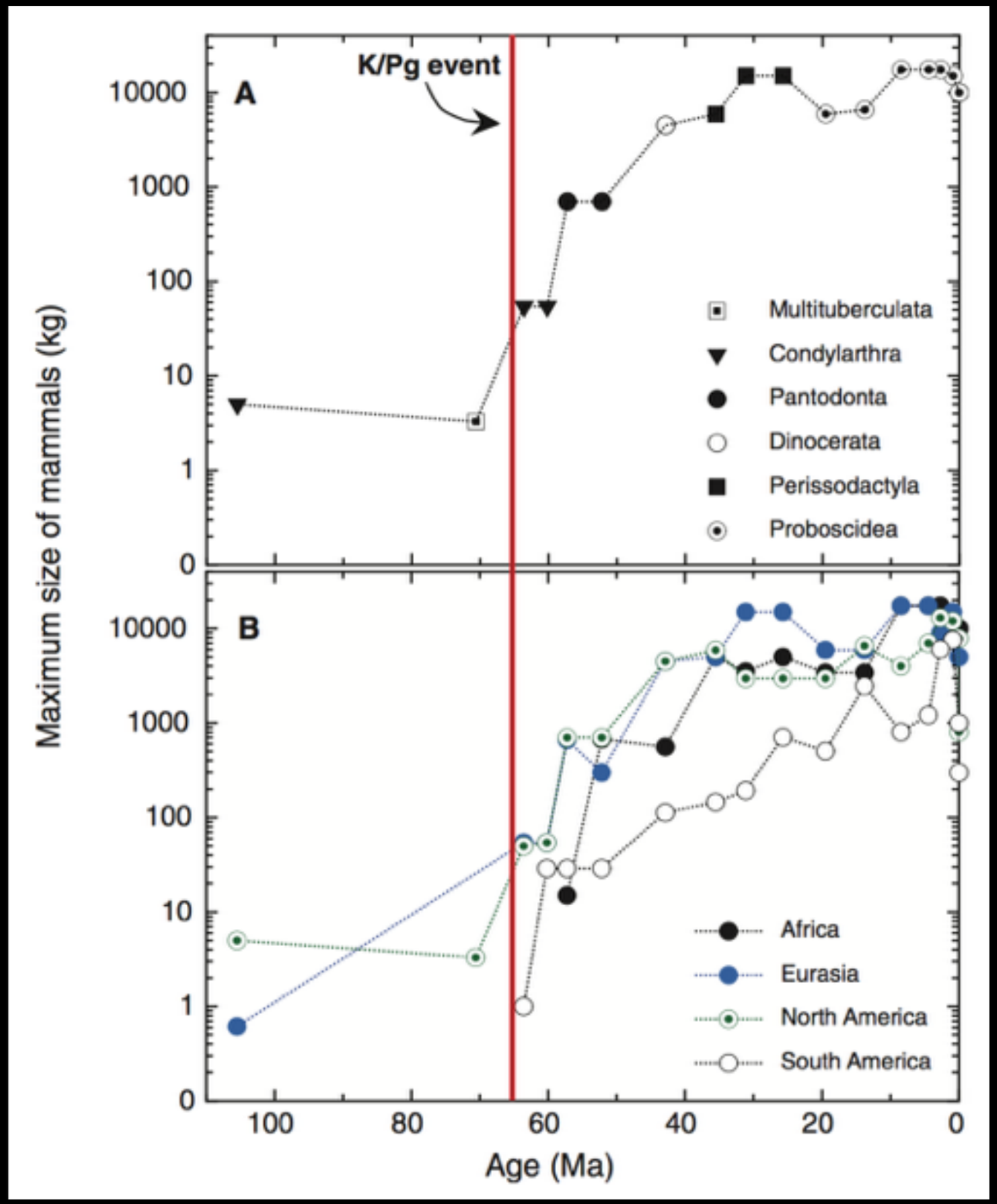
Predator prey relationships





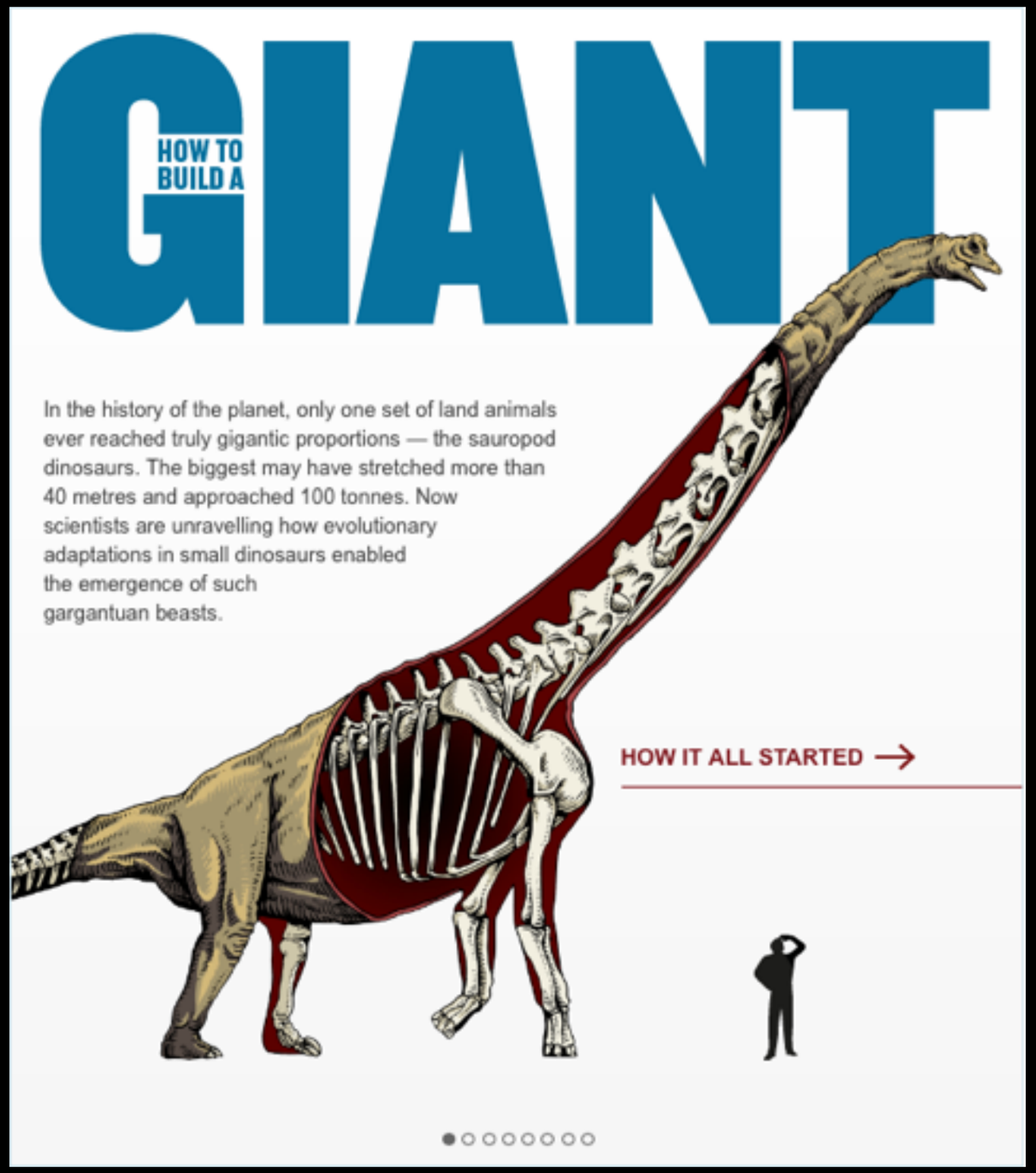
Dinosaurs and Body size

Filling up available niche space



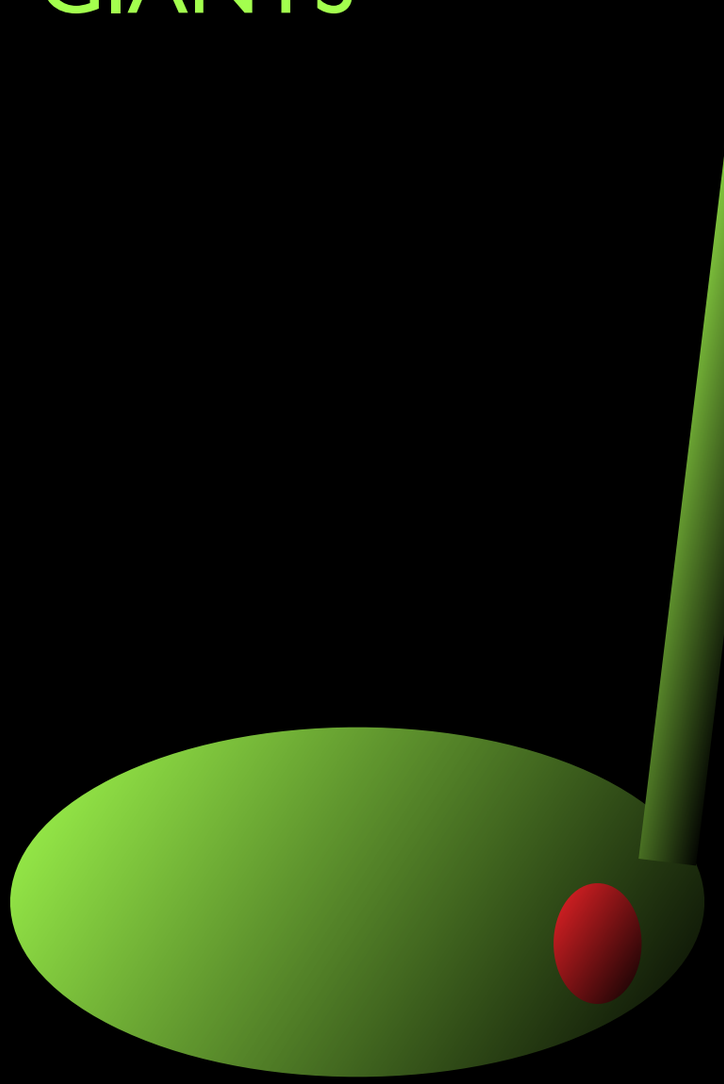
Dinosaurs and Body size

How to build a GIANT



http://www.nature.com/news/2011/110713/fig_tab/475159a.html

GIANTS

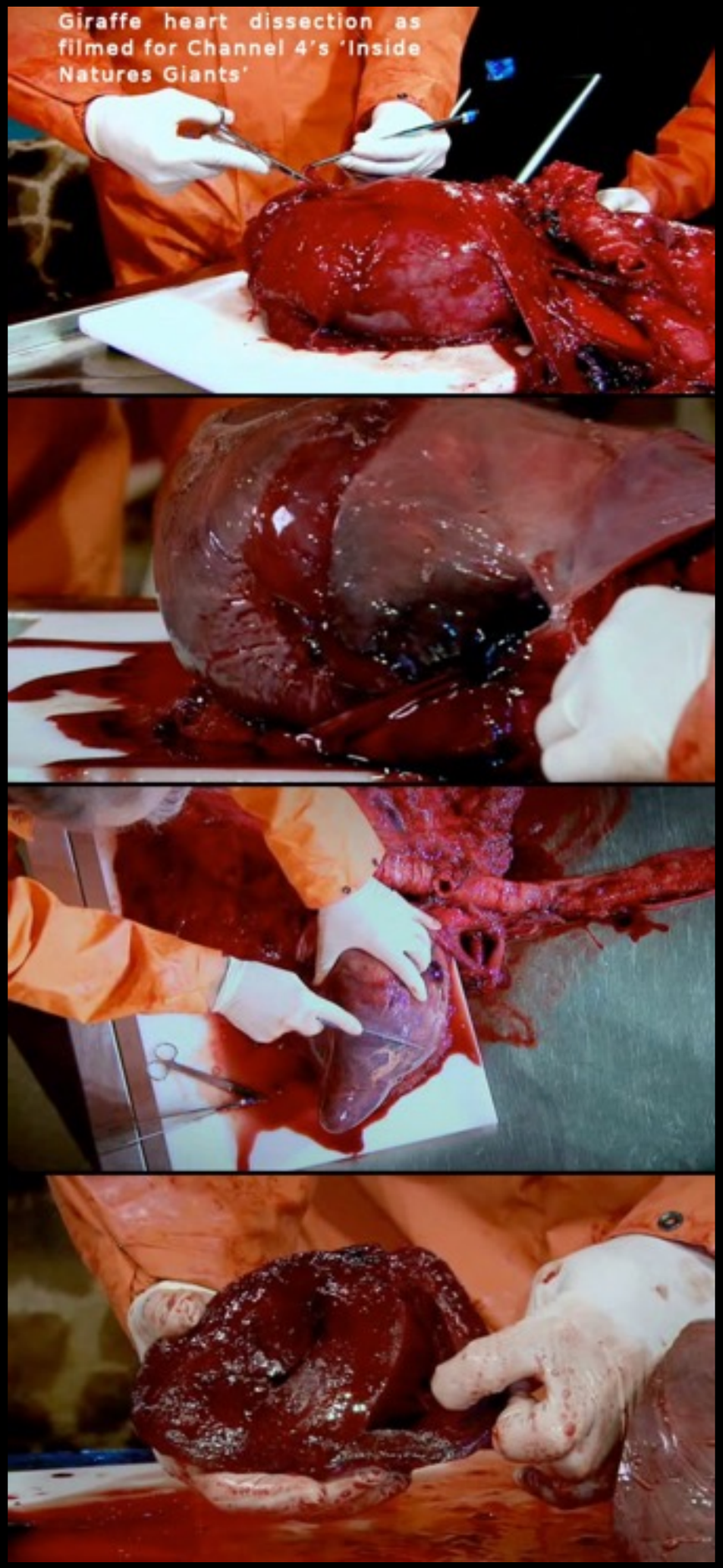


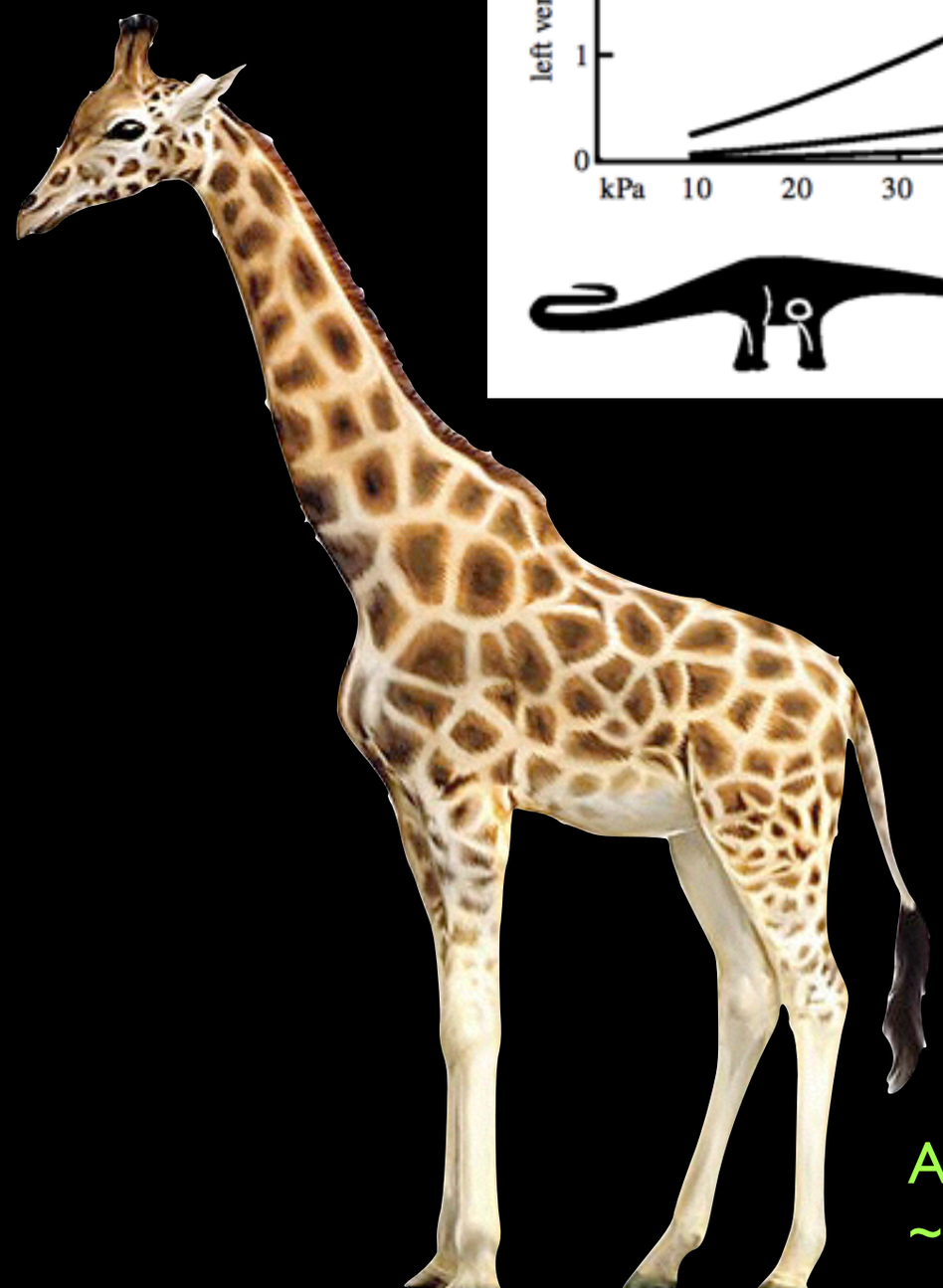
Cooling tower

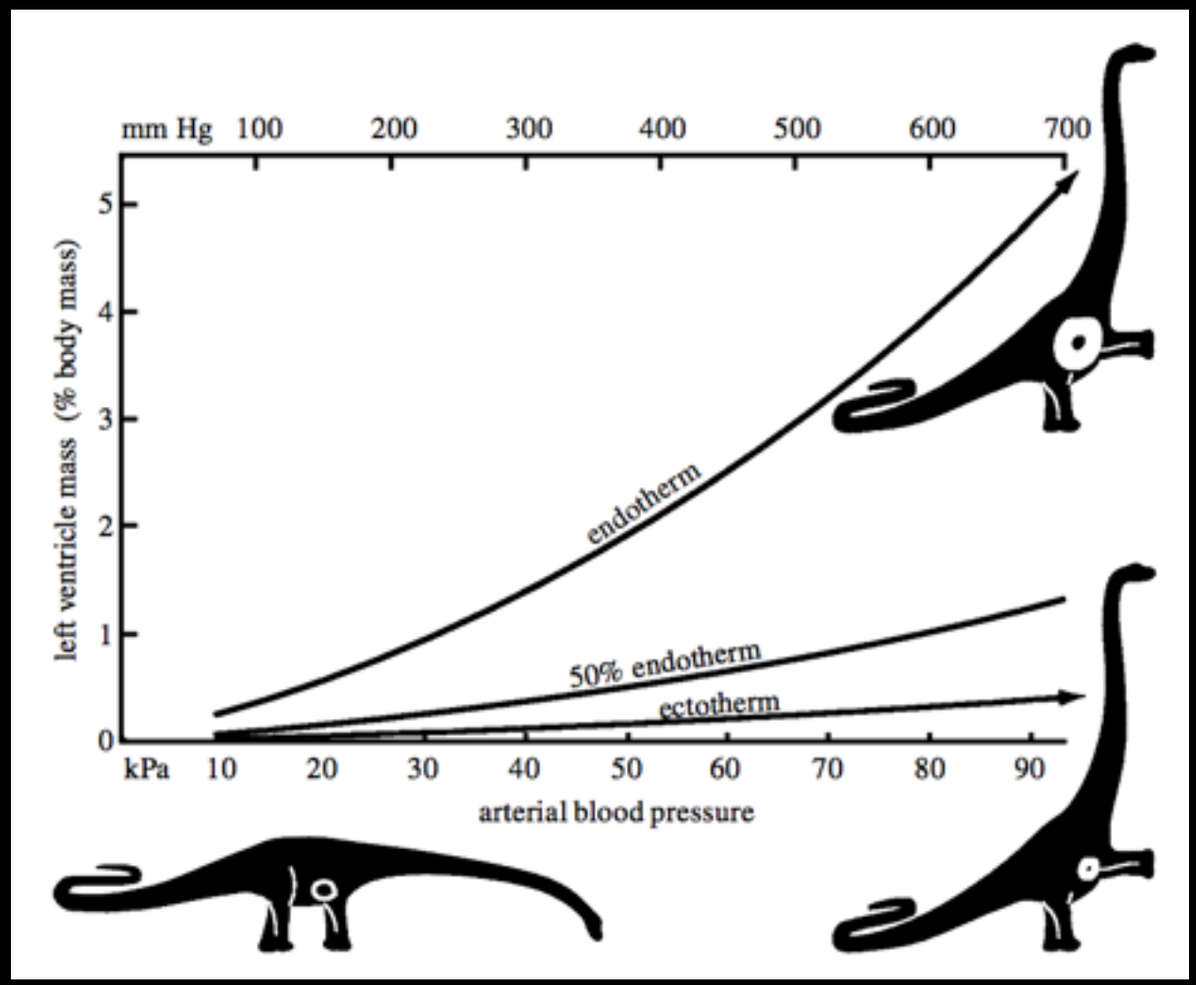
700 mmHg (typical animals: 100 mmHg)
Heart wall muscle scales with arterial blood pressure

How did sauropods pump blood to their heads?

High heat production (digestion)
Low SA:V ratio retained heat



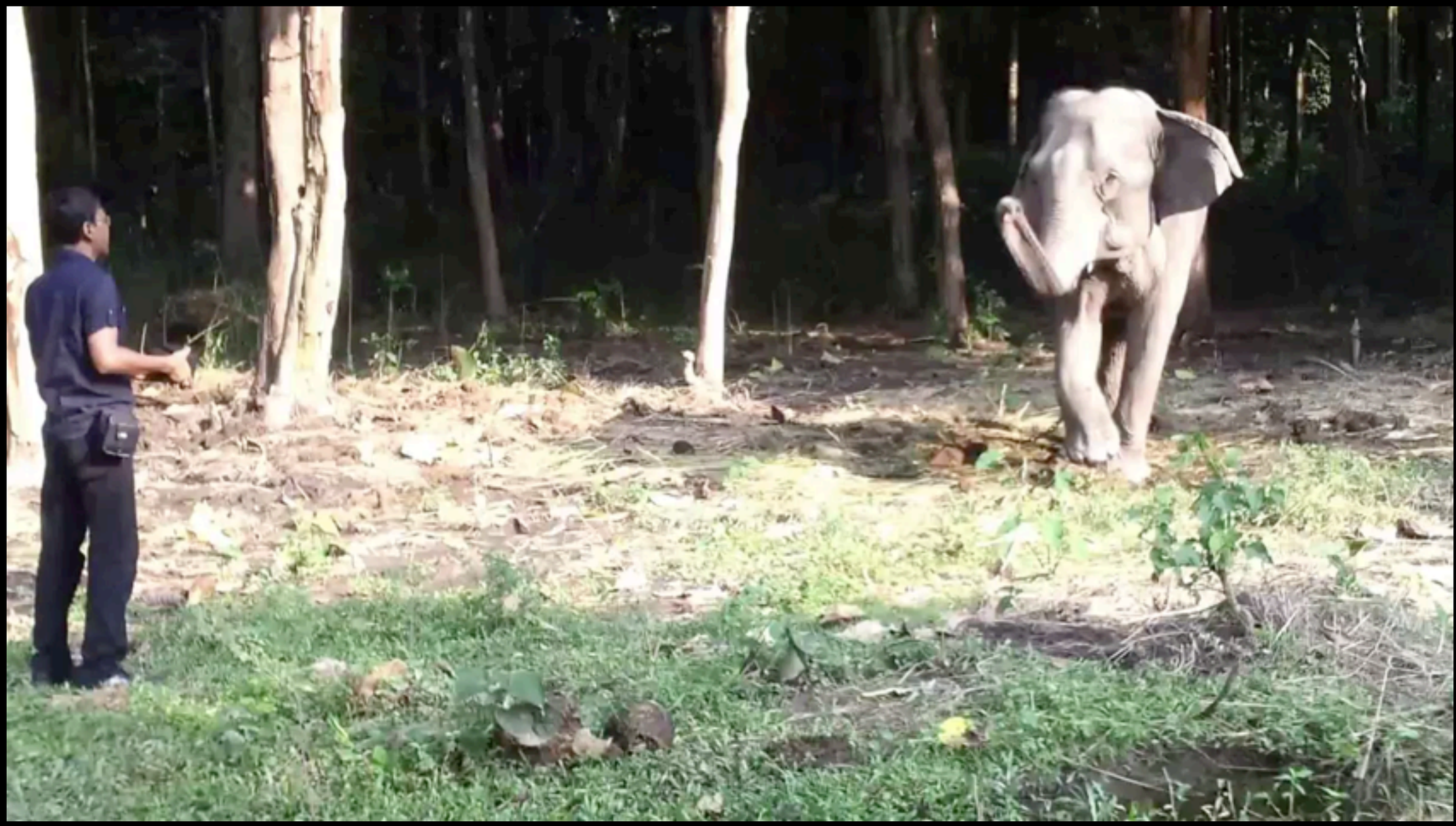




Arterial blood pressure:
~200 mmHg (2x norm)

Large body-sized animals: large distances

Elephant Ultrasonics



Tail variations involve and increase in tail vertebrae from 44 - 80 (Apatosaurus & Diplodocus)
Why?

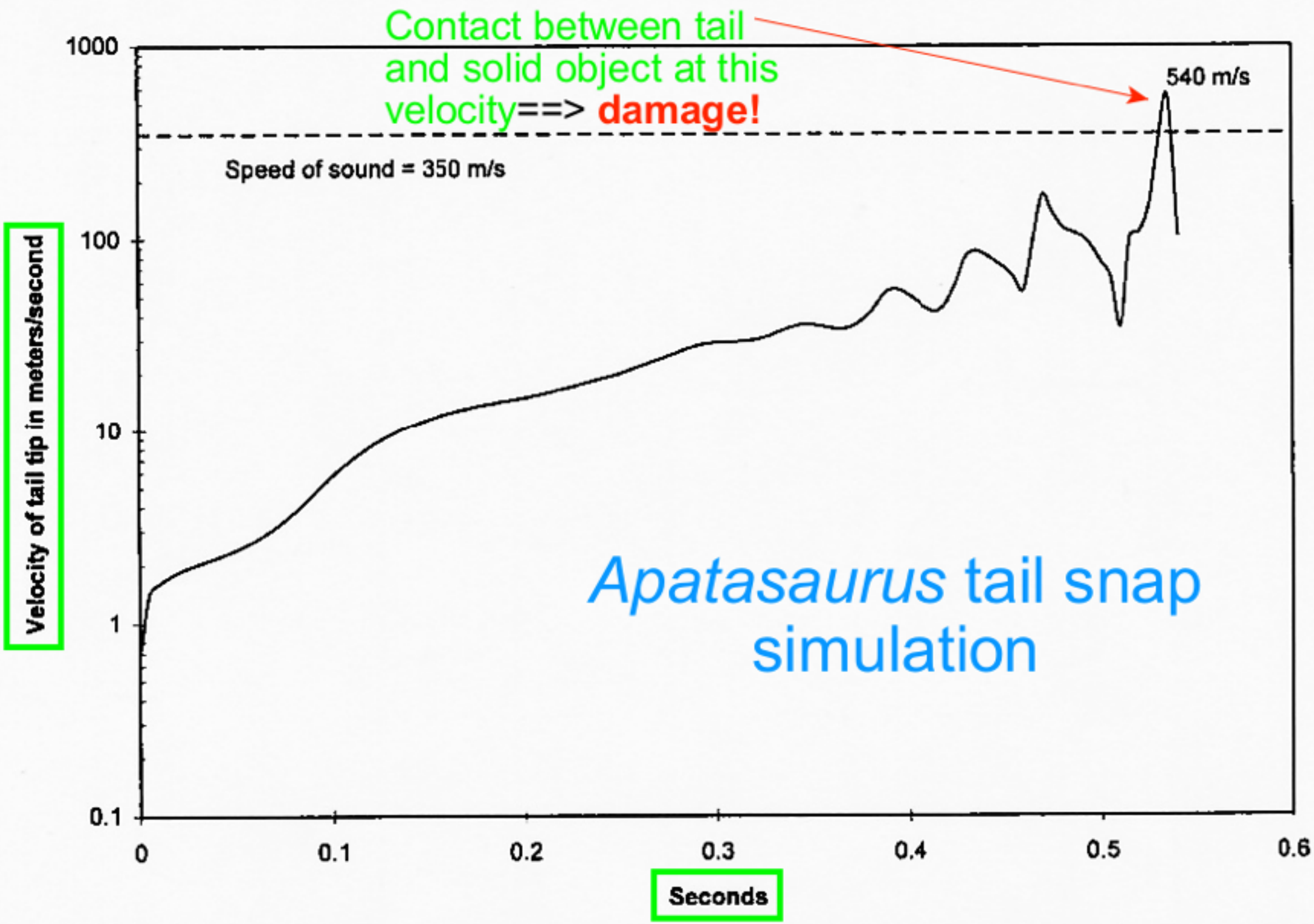


FIGURE 6. Distal tail tip velocity versus time from one simulation for the reconstructed tail of *Apatosaurus* CM 3018.

Supersonic Diplodocid tails?

FOR

1. Tail proportions work
2. Extreme thinness and elongation of distal tail vertebrae
3. Unusually long, stiffened vertebrae at the very end of the tail

AGAINST

1. Tail tips highly vulnerable to damage on impact
2. No poppers found in the fossil record!

"It is pleasant to think that the first residents of Earth to break the sound barrier were *not* humans."