Adaptation and constraints in endotherm and ectotherm body temperature evolution

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Do endotherms & ectotherms have similar inertia in thermal evolution, after accounting for their response to the environment?

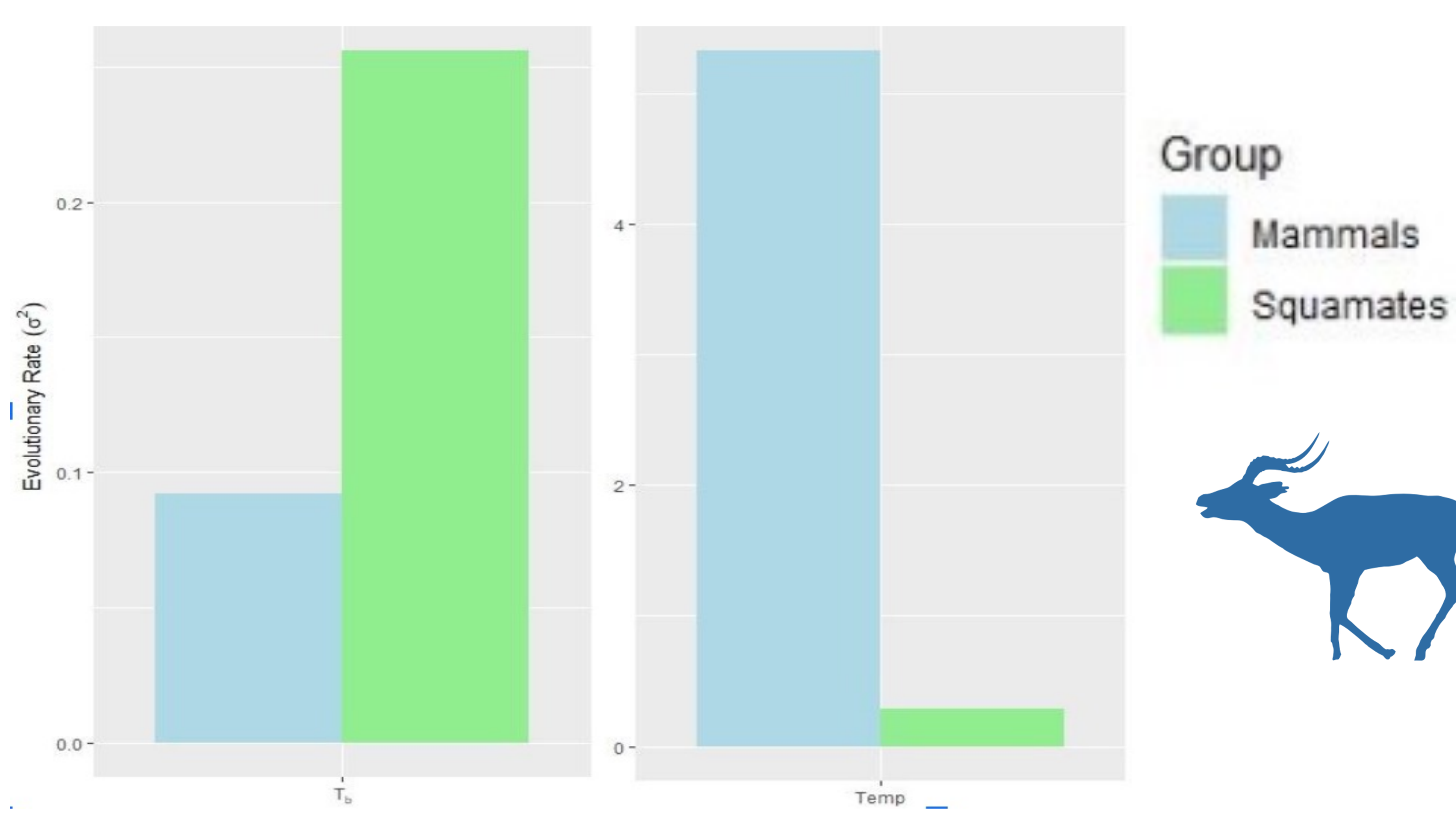
Hypotheses

Ectotherms evolve faster in preferred body temperature due to link with environment

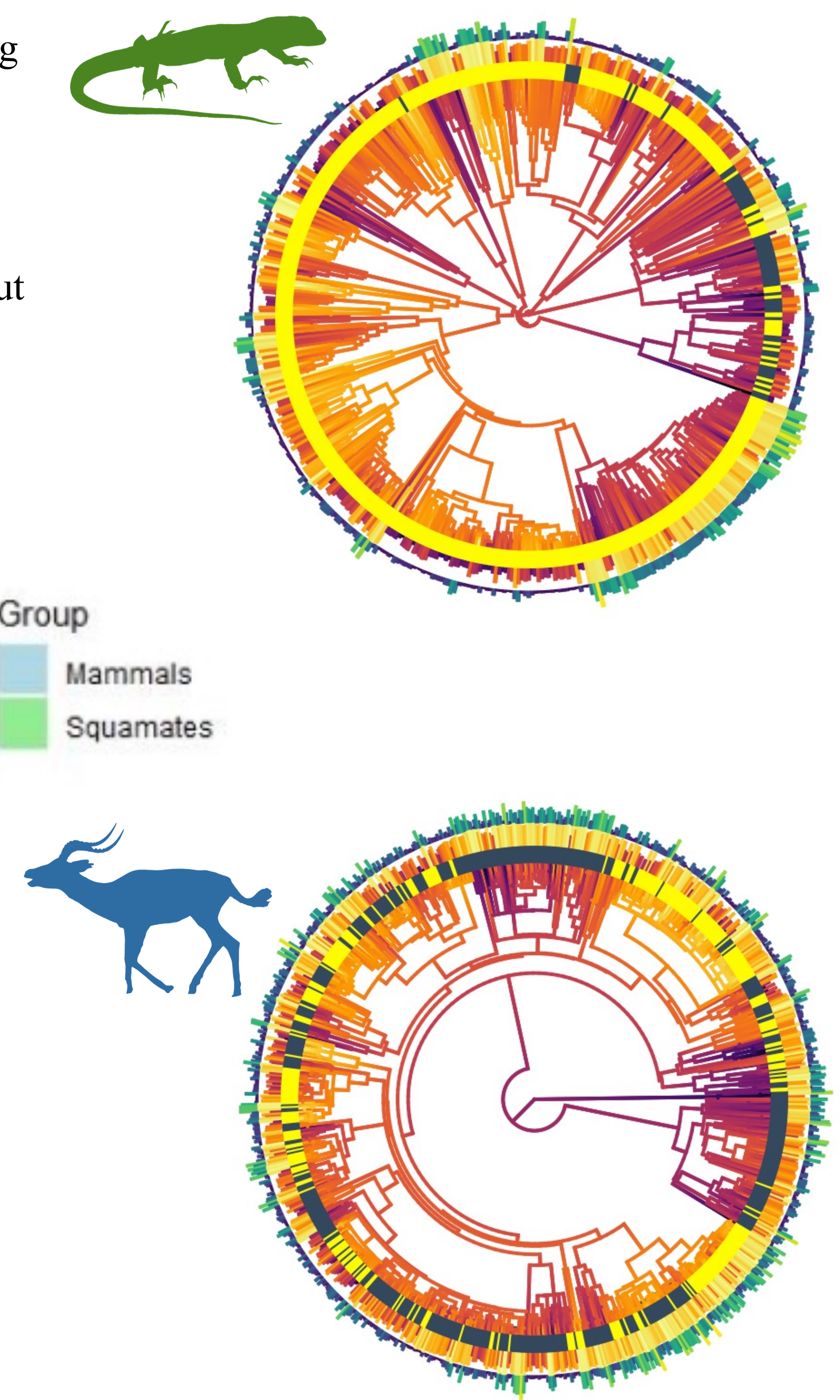
Endotherms break the link with environment, freeing their environmental niche to change independently (endothermy = a Bogert effect)

Prediction: Endotherms & Ectotherms have similar levels of inertia in evolution of body temperature, but differ in link to environment.

Brownian motion rates

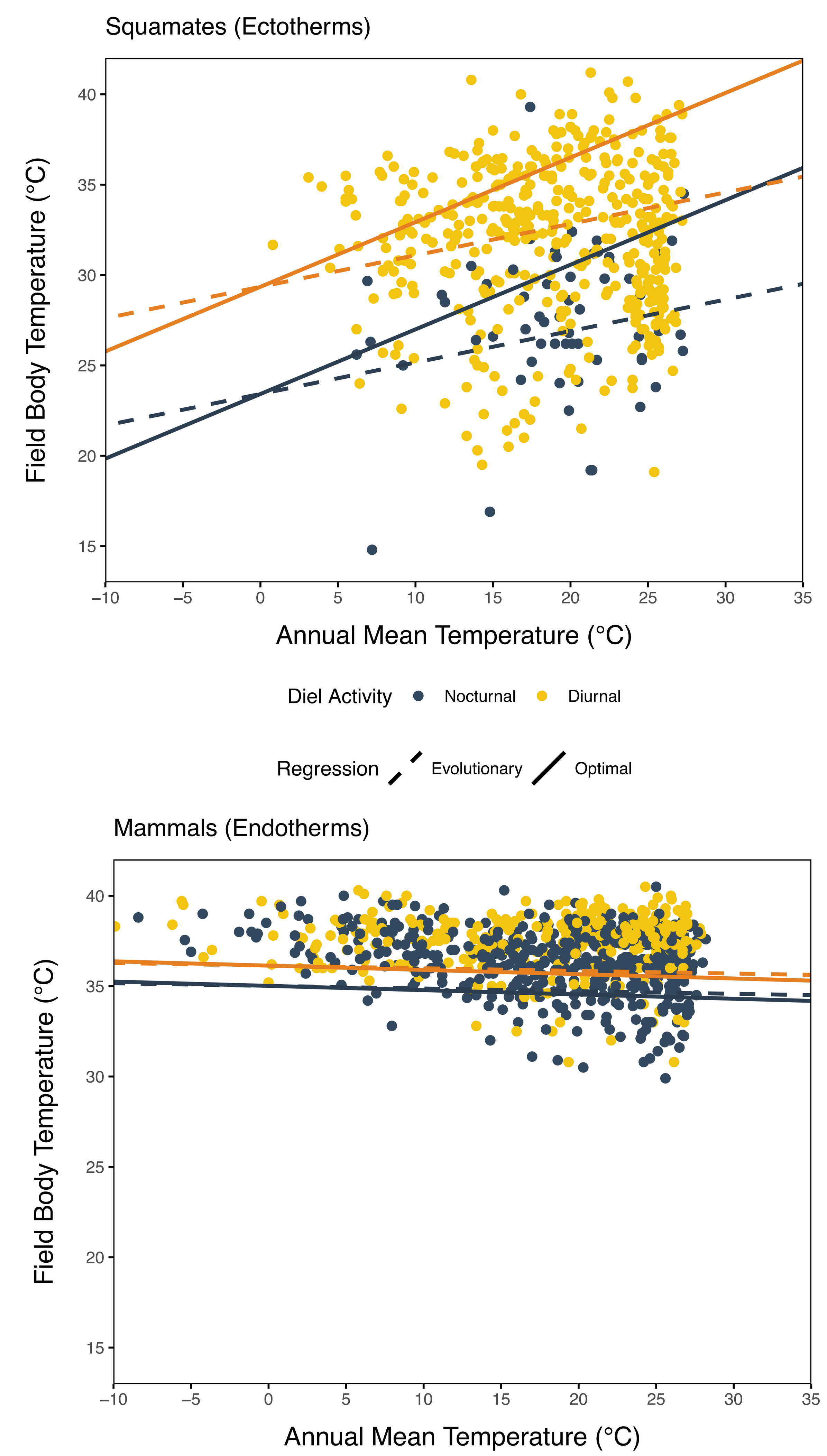


Squamates evolve preferred body temperature ~3x faster than mammals, but evolve average environmental niche temperature ~18x slower than mammals



Branch color – Body Temperature
Inner ring - Diel activity
Middle ring - Environmental temperature
Outer ring - Precipitation.

Best-fitting SLOUCH models



Best-fitting SLOUCH models

Group	Squamates	Mammals
N	500	813
Predictor(s)	Temp+Precip +Diel	Temp+Precip +Diel
$t_{1/2}$(my)	76.71	63.18
α (my^{-1})	0.01	0.01
Vy (°C^2)	15.57	3.54
R^2	0.13	0.01
Θ_{noc} (°C)	23.4	35.01
Θ_{diu} (°C)	29.3	36.13
Evolutionary slopes:		
β_{temp} (°C/°C)	0.17	-0.015
β_{precip} (°C/100 mm)	-0.19	-0.0007
Optimal slopes:		
β_{temp} (°C/°C)	0.358	-0.023
β_{precip} (°C/100 mm)	-0.391	-0.00116

Endotherms and ectotherms have similar levels off phylogenetic inertia, after accounting for environmental factors.
Suggests universal constraints on thermal physiology in vertebrates.

Ectotherms respond strongly to environmental temperature, but with significant inertia.
Endotherms show significant, but weak countergradient response.

References & Data Sources: 1. Qu & Wiens, 2020, Evolution 26(8):414-423. 2. Moreira, et al. 2021. Evolution Letters 5(5):484-494. 3. Hansen et al. 2008. Evolution 62(8):1965-1977. 4. GBIF.org, 2022, GBIF Occurrence Download. 5. Species360 (2022), www.species360.org 6. Munoz, 2014. Proc B 281(1778):2413-2433. 7. Bodensteiner et al. unpublished. 8. Munoz, 2021. Evolution 76(S1):49-66. 9. Upham et al. 2019. PLOS Biology. 10. Tonini et al. 2016. 204:23-31.