



Global body size patterns of bats refute Bergmann's Rule



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INTRODUCTION

Bergmann's rule predicts mammals are larger at higher latitudes (Bergemann, 1847, Fig. 1). Few studies have tested this in bats.

Understanding the trend of Bergmann's rule is important as it can explain the influences of an animal's life history. There is also importance in conservation of the species, as body size helps predict extinction risks (e.g. Jones et al. 2003).

We tested the generalizability of Bergmann's rule using an order of extant bats (Chiroptera) in a phylogenetic framework.

METHODS

We gathered body size and latitudinal data for all extant bat species using The International Union for Conservation of Nature (IUCN) and Wilson & Mittermier (2019).

We reconstructed a bat phylogeny from Welch and Beulieu (2018) to control for non-independence.

We tested Bergmann's rule using a PGLS model that included body size (g) as the response variable and latitude as the explanatory variable.

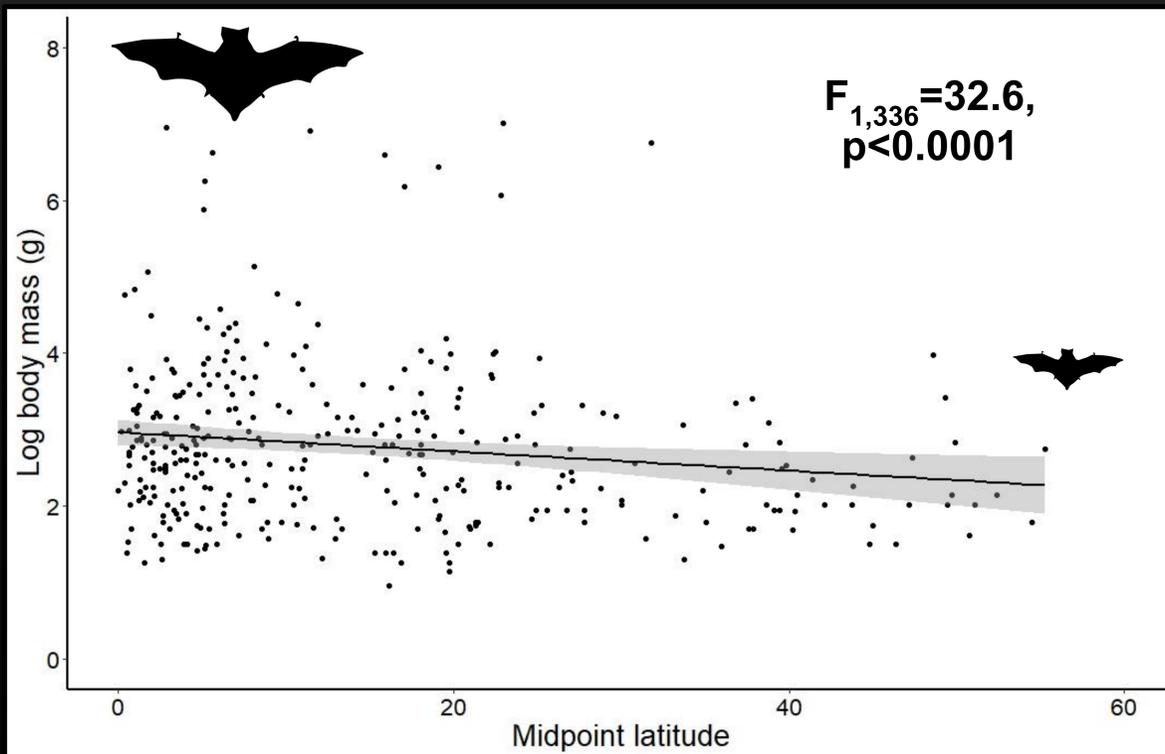
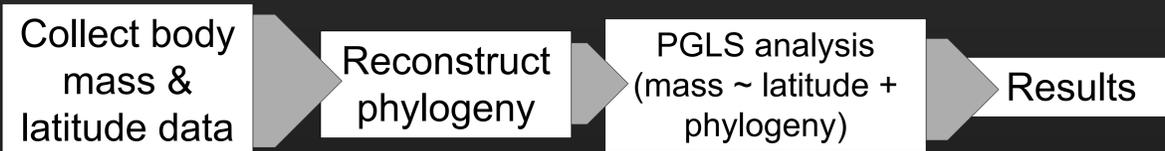
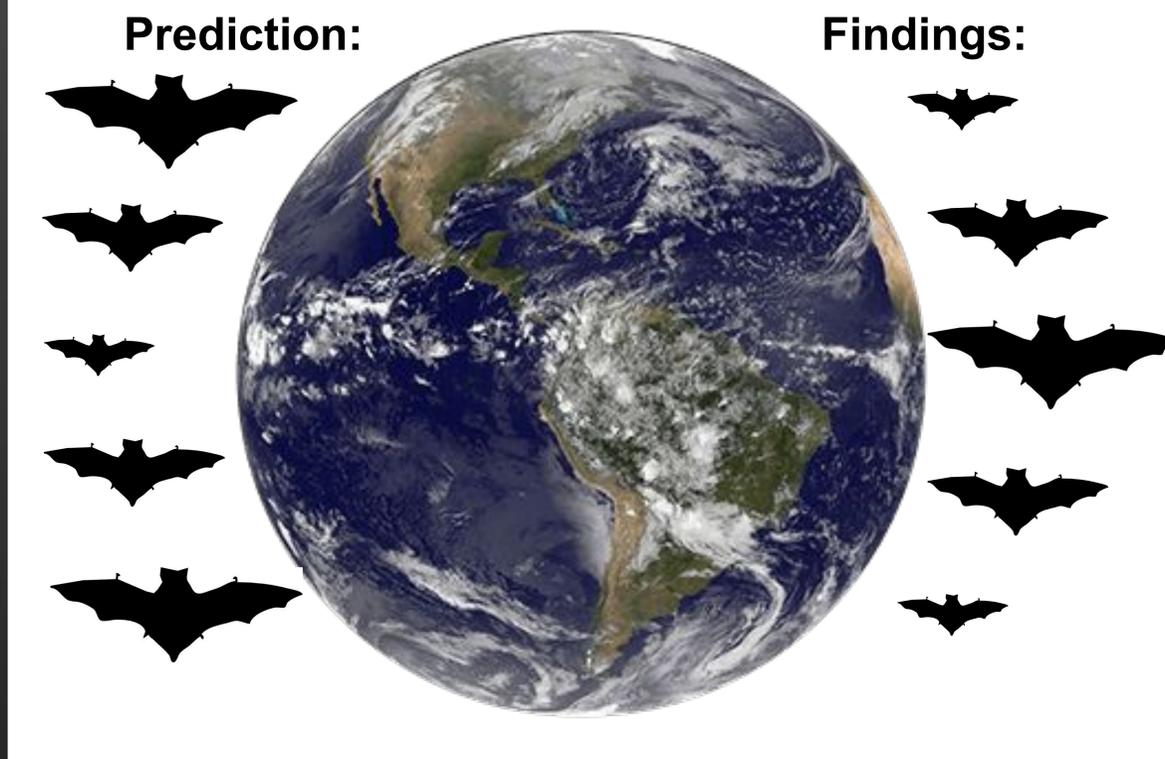


Figure 1: Larger bats were found near the equator, the opposite pattern expected under Bergmann's hypothesis.

RESULTS

Based on our PGLS of all bats, larger bats were found near the equator (Fig. 2., $F_{1,336} = 32.6, p < 0.001$).

In family specific analyses, latitude was related to body PC1 in Emballonuridae ($F_{1,14} = 11.9, p = 0.004$) and Phyllostomidae ($F_{1,48} = 5.72, p = 0.02$).

DISCUSSION

In contrast to Bergmann's rule, larger bats were found at lower latitudes.

The effect latitude of however, was only found in two bat families; all others showed no effect.

Valerius Geist (1987) and Marcus Clauss and colleagues suggest that Bergmann's rule describes a fundamental principle within mammals, but that its expression has been modified by a variety of factors during mammalian diversification yet to be resolved. This is however only the first comprehensive study done for bats.

Because body size predicts extinction risk (Jones et al. 2003, Welch and Beaulieu 2018), insights into body size distributions can inform conservation.

LITERATURE CITED
 Clauss, M., Dittmann, M. T., Müller, D. W. H., Meloro, C., & Codron, D. 2013. *Bergmann's rule in mammals: a cross-species interspecific pattern.* *Oikos* 1-8.
 Geist, V. 1987. Bergmann's rule is invalid. *Canadian Journal of Zoology*. 65: 1035-1038.

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