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Bats and Rats: Evolutionary Implications of Hindlimb Development

Tara Hobbs

Rick Adams

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Tara E. Hobbs and Rick A. Adams
University of Northern Colorado

INTRODUCTION

- Bats show great variations in phenotypic expression in extinct and extant relatives [4].
- Microchiropteran bats are much more willing and able to move their limbs while walking whereas the megachiropteran limb movement was more closely aligned to the motions of climbing [1].
- Based on musculoskeletal evidence, megabats evolved later from a primate ancestor whereas microbats evolved from an insectivorous terrestrial mammal [3].

HYPOTHESES

H1: Relative growth of the femur and tibia will occur at the same rates within bats and within mice
H2: Growth rates of the hindlimb will differ between mice and bats due to different modes of locomotion

MATERIALS & METHODS

- All measurements were taken on Seba's short-tailed bats
- Specimen were previously cleared and stained using alcian blue (cartilage) and alizarine red (bone)
- Greatest length measurements (mm) were taken of the femur, tibia, and skull using an Olympus microscope with an ocular ruler
- Data on a terrestrial ancestor in a mouse model was collected from the literature [2]
- Regression analysis was used to find correlations between models

RESULTS

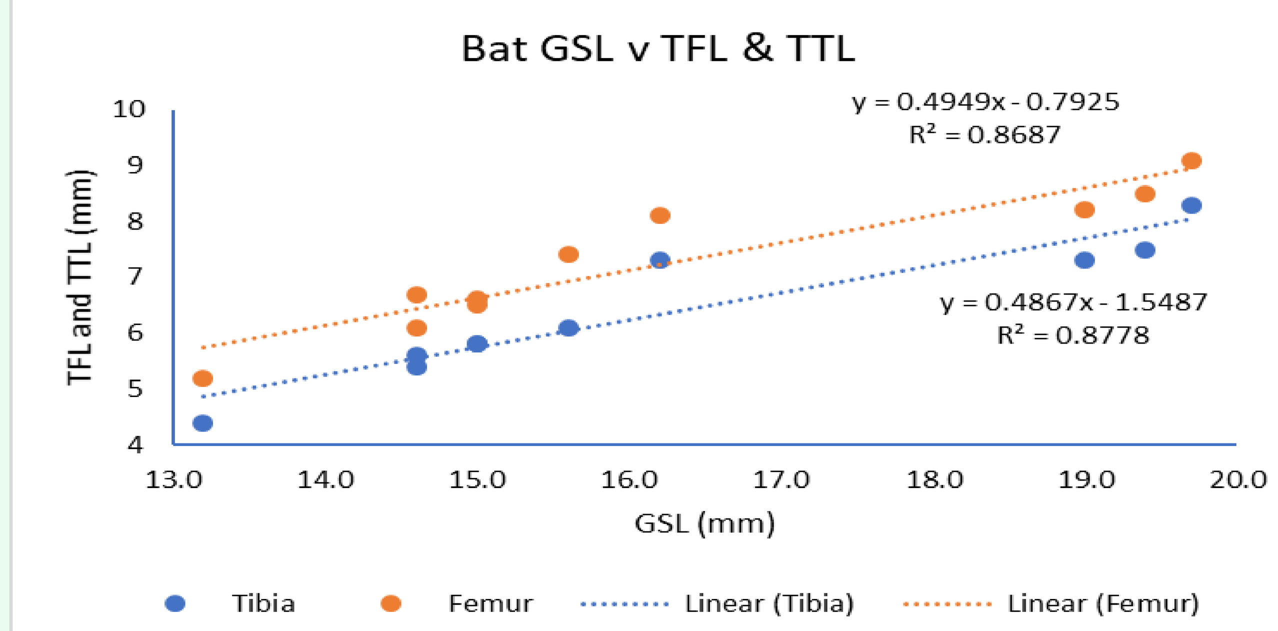

Figure 1 The positive relationship between femur growth and tibia growth in the bat model in relation to skull length.

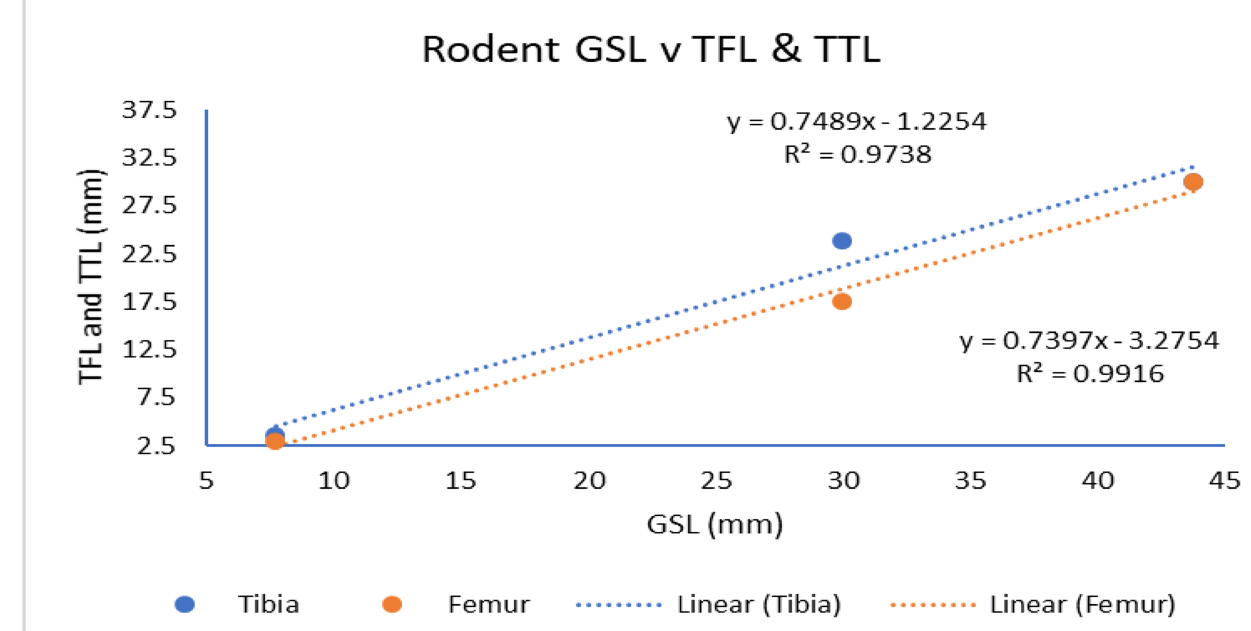

Figure 2 The positive relationship between femur growth and tibia growth in a mouse model in relation to skull length.

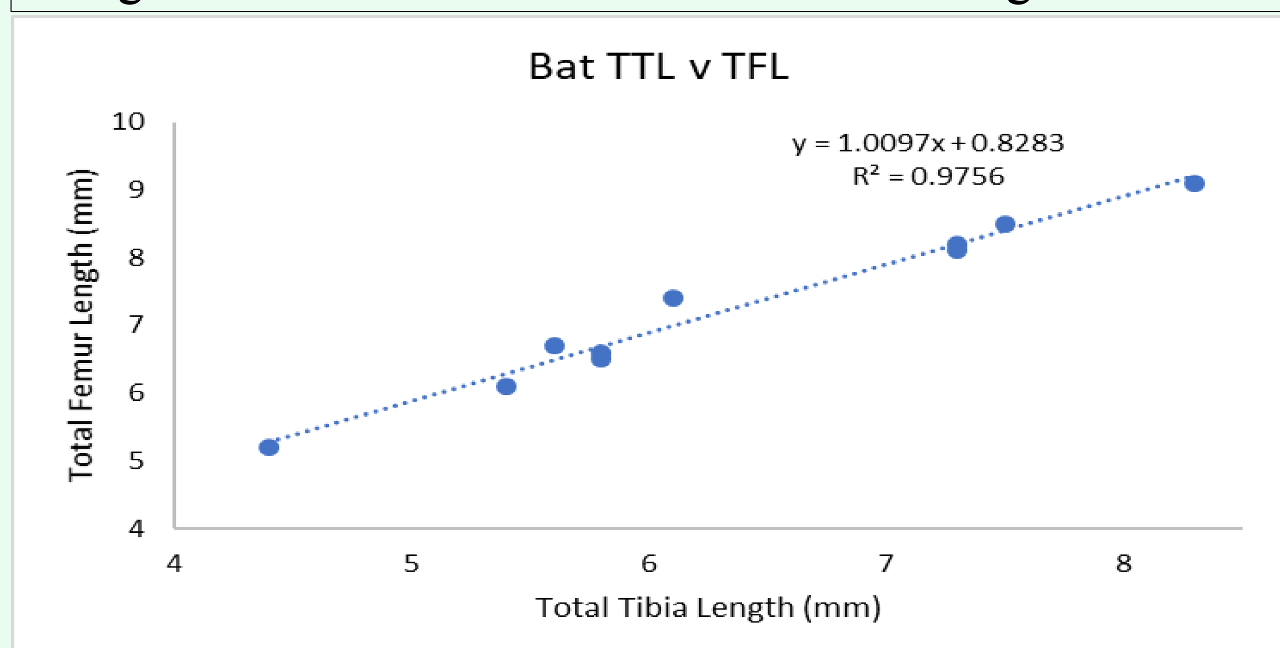

Figure 3 Positive allometric growth rate relative to the femoral and tibial relationship in bats

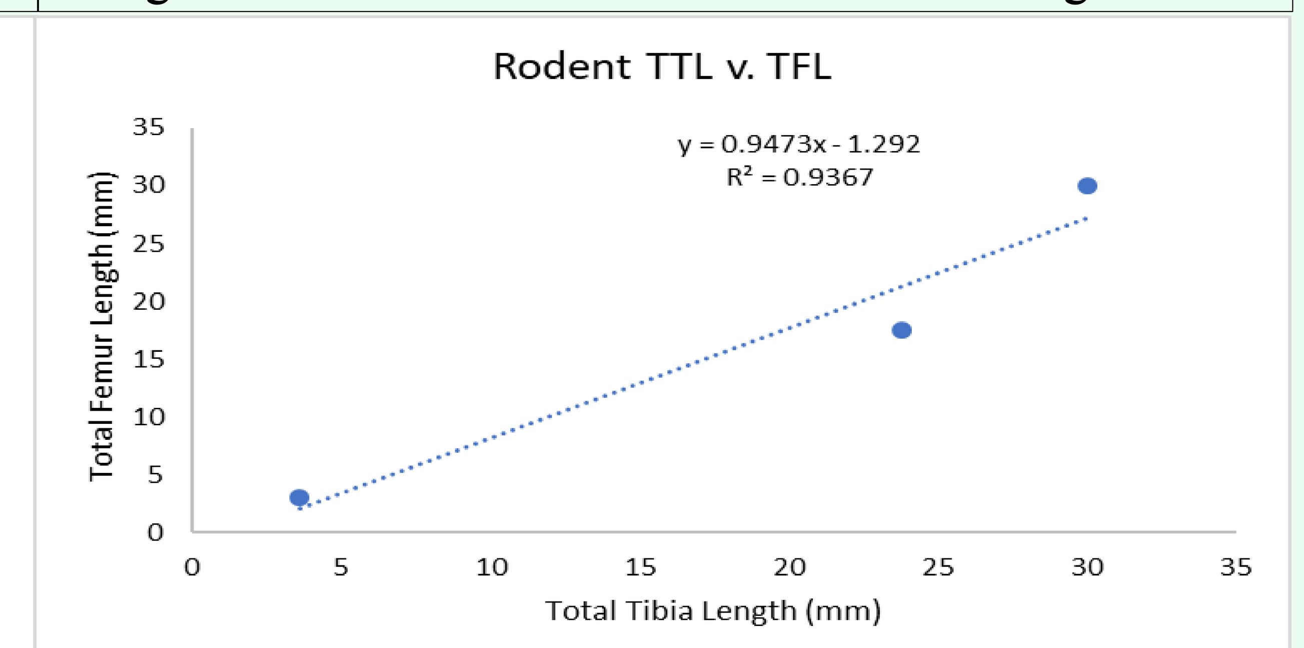

Figure 4 Negative allometric growth rate relative to the femoral and tibial relationship in mice

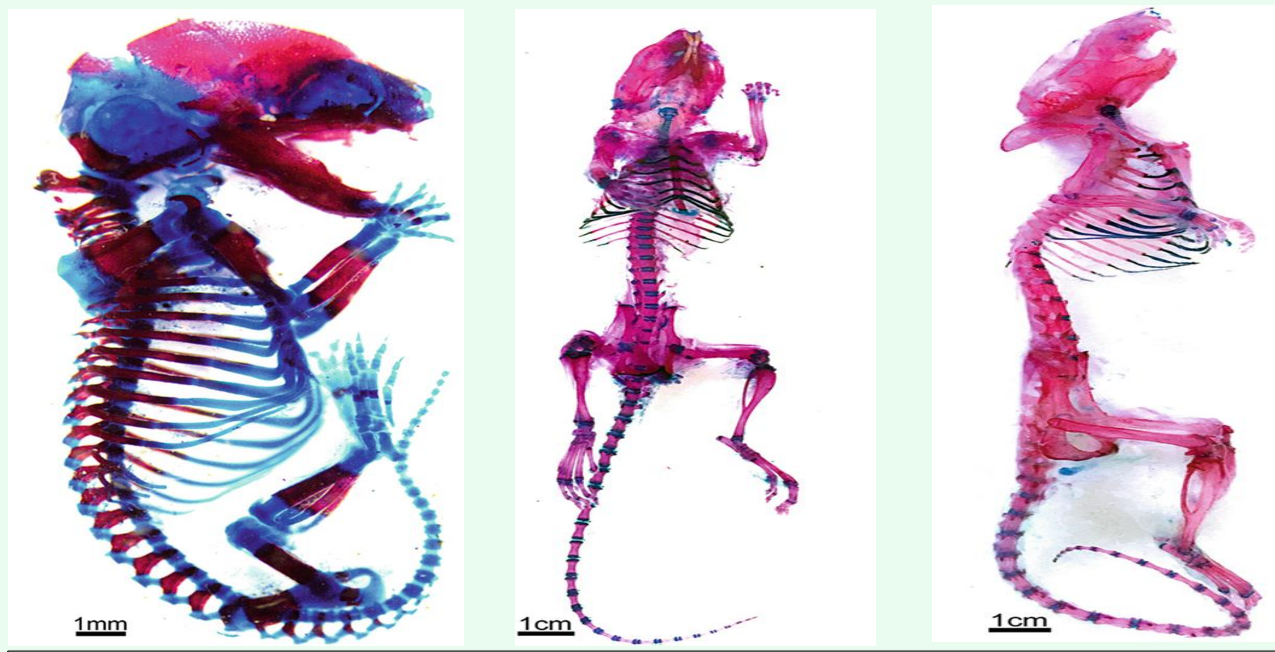

Figure 5 Cleared and stained mouse specimen that were used to calculate the regression analysis in the terrestrial comparison

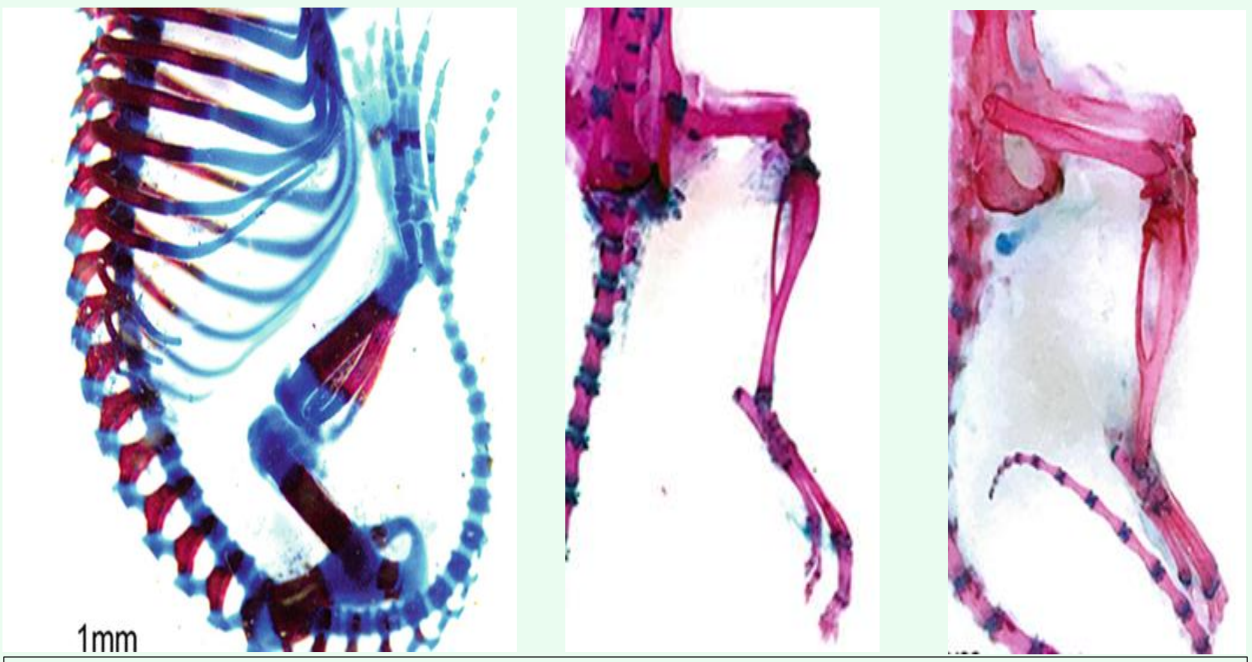

Figure 6 Closer view of the distal limb elements that were measured during this study

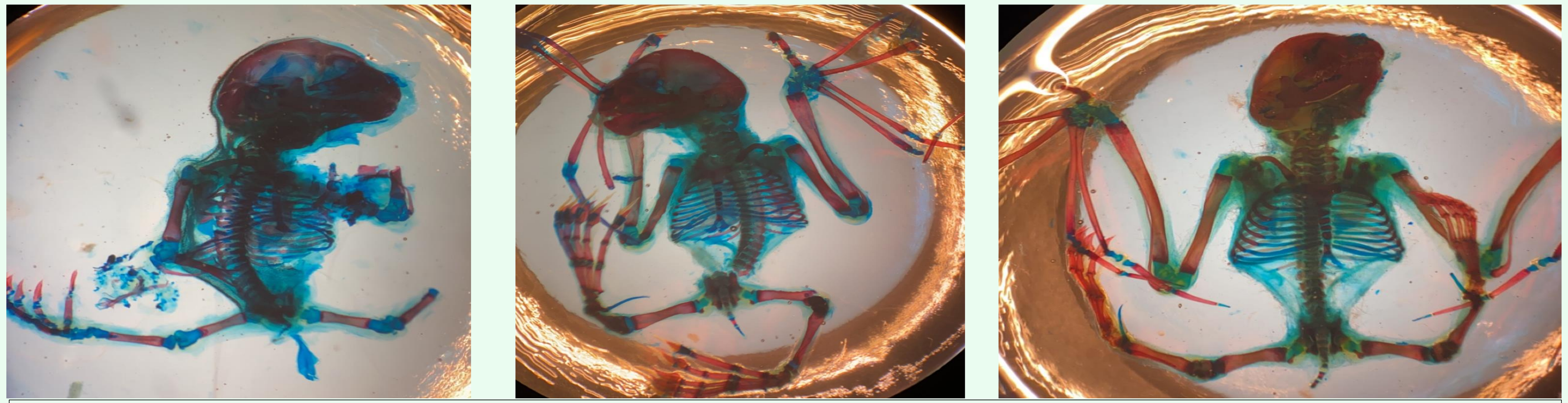

Figure 7 Three of the specimen that were used during the data collection process were photographed during data collection. The specimen range from our youngest individual to our oldest individual (ages are predicted via greatest skull length measurement and allometric relationships of skull size to age).

CONCLUSIONS

- *Carollia perspicillata* showed equal slopes for femur (slope = 0.49, R^2 = 0.87) and tibia (slope = 0.49, R^2 = 0.88) growth indicating that the hindlimb elements grow at similar rates to each other, but the femur outpaces the tibia relative to the skull in bats than in mice supporting H2
- Regressing tibia and femur lengths against each other showed that the growth rate in *C. perspicillata* showed a positive allometric growth rate (slope = 1.1, R2 = 0.98) indicating that femur growth outpaced tibia growth in bats whereas in mice (slope = 0.95, R2 = 0.94) of the femur to the tibia had negative allometry with the tibia outpacing the femur, which tests H1
- These data indicate that the ontogeny of the hindlimb in bats has shifted away from a more ancestral terrestrial mammal due to selective pressures around the evolution of flight

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