Bat craniovertebral morphology across dietary regimes

Neysa Grider-Potter, D-103

Project Description

Abstract

The semicircular canals and vestibule sense angular and linear accelerations of the head and facilitate visual stability and whole-body coordination. Size, shape and orientation of these canals has long been associated with sensitivity to head motion and locomotor agility. As a clade, bats are among the most agile of mammals practicing astounding feats of aerial agility in order to capture flying prey. However, there is variation in locomotor capabilities within bats that tend to fall along dietary regimes with insectivorous species being more agile than their frugivorous relatives. Further, there is extreme variation in cervical morphology that is largely lack functional explanation. Because the cervical spine balances and moves the head, the stability requirements of the inner ear should influence vertebral morphology. The goal of this work is to understand how inner ear morphology varies among bats of diverse dietary habits and if inner ear morphology is, in turn, shaping the cervical spine.

Significance

Bats are the only mammalian group to have evolved power flight. This unique mode of locomotion, as well as their echolocation abilities, has significantly shaped their anatomy and allowed them to radiate into a diverse array of dietary niches. Understanding how inner ear morphology both is influenced by dietary habits and covaries with vertebral morphology expand our knowledge about mammalian functional anatomy. These relationships between form and function have the potential to be applied to the fossil record to understand more about bat evolution.

Objectives

Here we aim test the hypotheses that 1) semicircular canal and vestibular morphology varies among bat taxa alongside dietary habits and 2) bats with more agile morphologies (i.e. larger canal radii of curvature, more orthogonally-oriented canals, enlarged vestibule) will have more gracile cervical vertebrae (e.g. thinner laminae, shorter transverse and spinous processes).

Methods and student responsibilities

The student will be primarily responsible for measuring and scanning bat specimens. Scan data will primarily be analyzed in 3D Slicer and Rhinoceros. The student will be trained in these programs along with the use of the microCT scanner. Hypotheses will be tested using relevant statistical analyses (ANOVA, linear regression). Coding

experience is encouraged but not required. Results of this study have the potential to be published as a student-led peer-reviewed journal article and contribute to other ongoing projects.

Training and Mentoring Plan

Training in project methods will be provided by the PI as needed throughout the duration of the fellowship. Students are welcome to attend the weekly Musculoskeletal Research Focus Area journal club. Research will be primarily conducted on campus with the potential for occasional remote work depending upon computer power and availability.