



Analysis of Mandible Morphology of *Antrozous pallidus* and Environmental Factors



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Abstract

The pallid bat, *Antrozous pallidus*, displays geographic variation in morphology of the jaw. Using GIS, morphological data as well as information about specimen gender was overlaid with environmental factors which may be creating selection pressures for *A. pallidus*—namely vegetation, evaporation, precipitation, and ecoregion. The current project has been limited to the bat's range in New Mexico, but will be expanded for the entire range.

Introduction

This project is part of a larger research topic for Biology 85: Independent Research. I am currently investigating geographic variation in the pallid bat, *Antrozous pallidus*. Specifically, I am measuring morphological variation in the jaw of *A. pallidus*, and using that information to make inferences about the bat's trophic ecology—its feeding preferences and how they vary by geographic location. Variations in mechanical advantage of the jaw imply different prey types. I have therefore taken measurements relating to mechanical advantage, and have found variation by latitude. Using GIS, I have been able to expand this analysis by mapping specimens by their collection locality, and combining my measurement data with environmental factors for the collection site, including ecoregion, precipitation, vegetation, and evaporation. All of these factors contribute to the type of insect communities present in an area (which is a selective pressure for mechanical advantage of the jaw). Also, climatic factors create other selective pressures on bats, including thermoconservation.

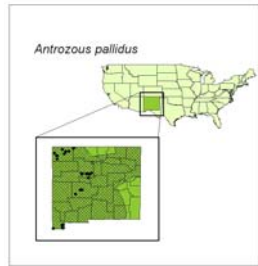


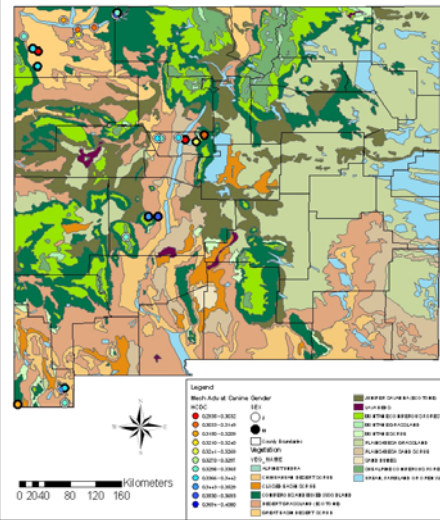
Figure 1. New Mexico with Range and Specimen Locations

New Mexico is highlighted as the study area. The range of *A. pallidus* in New Mexico is indicated in black crosshatching. Specimen locations are denoted by the black dots.

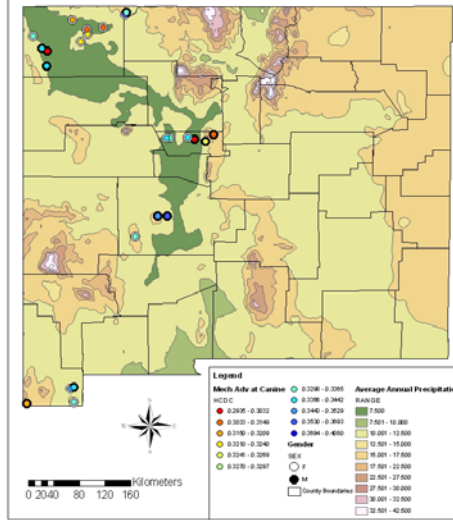
Methods

I began this project measuring bat specimens loaned from museums around the country. Using digital photography and ImageJ software, I recorded various measures of the mandibles which indicate mechanical advantage, including the height of the coronoid process relative to the distance from the articular condyle to the canine, and relative to the distance to the first molar. These measures are displayed as a layer by color categories. Data on environmental variables, including vegetation type, evaporation, precipitation, and ecoregion were overlaid with this morphological data. Ecoregion data was obtained from the USDA Forest Service, published by the US Geological Survey. Precipitation data was published by the Spatial Climate Analysis Service, Oregon State University with the USDA - NRCS National Water and Climate Center, Portland, Oregon and the USDA - NRCS National Cartography and Geospatial Center, Fort Worth, Texas. Vegetation and evaporation data were published by the Earth Data Analysis Center, Albuquerque, New Mexico. Though data was collected for the entire range of *A. pallidus*, this GIS analysis was limited to specimens in New Mexico due to time constraints and in order to more efficiently establish a methodology.

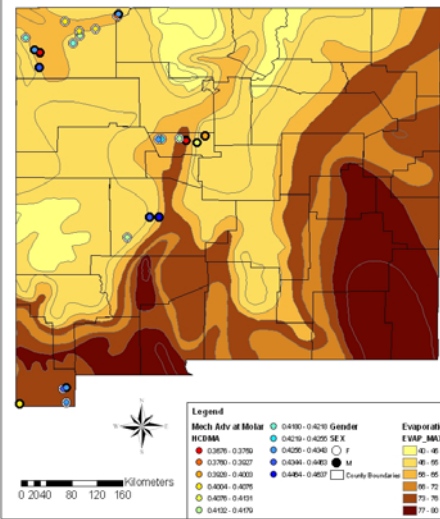
Gender, Mechanical Advantage (at Canine), and Vegetation Type



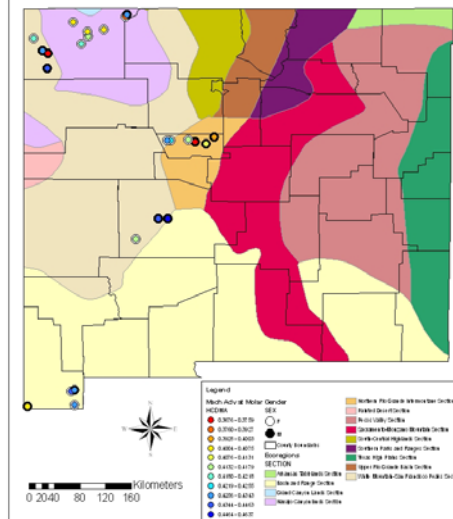
Gender, Mechanical Advantage (at Canine), and Precipitation



Gender, Mechanical Advantage (at Molar), and Evaporation



Gender, Mechanical Advantage (at Molar), and Ecoregion



Results and Discussion

The maps created in this project display morphological characters as a series of colors, varying across the color spectrum as an indication of varying mechanical advantage. For each specimen location, the bat's gender is also displayed. In this way, the effects of gender and environmental variables are simultaneously visible, allowing for a side-by-side visual comparison. The methodology employed in this project may be expanded to the entire range of *A. pallidus*, as well as to other study species. When this work is expanded, and a larger area is mapped, spatial analysis may be done to identify trends in mechanical advantage.

Figure 2. Gender, Mechanical Advantage, and Vegetation Type

This map displays gender and mechanical advantage measures at the canine for New Mexico specimens. Vegetation data was projected using GCS_Assumed_Geographic_1, Datum was D_North_American_1927

Figure 4. Gender, Mechanical Advantage, and Precipitation

This map displays gender and mechanical advantage measures at the canine for New Mexico specimens. Precipitation data was projected using GCS_Assumed_Geographic_1, Datum was D_North_American_1927

Figure 3. Gender, Mechanical Advantage, and Evaporation

This map displays gender and mechanical advantage measures at the first molar for New Mexico specimens. Evaporation data was projected using GCS_Assumed_Geographic_1, Datum was D_North_American_1927

Figure 5. Gender, Mechanical Advantage, and Ecoregion

This map displays gender and mechanical advantage measures at the first molar for New Mexico specimens. Ecoregion data was projected using GCS_Assumed_Geographic_1, Datum was D_North_American_1927

Further Studies

I plan to expand this map for the entire range of *A. pallidus*. Also, I would like to add elevation data as another layer to the map. When this is complete, I will incorporate the map document and analysis into my larger research study. This project may be used as a template for other researchers interested in the effect of environmental factors on morphology.

Acknowledgements

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