KENNESAW STATE UNIVERSITY

How does urbanization affect the morphology and genetic connectivity of small mammal populations?

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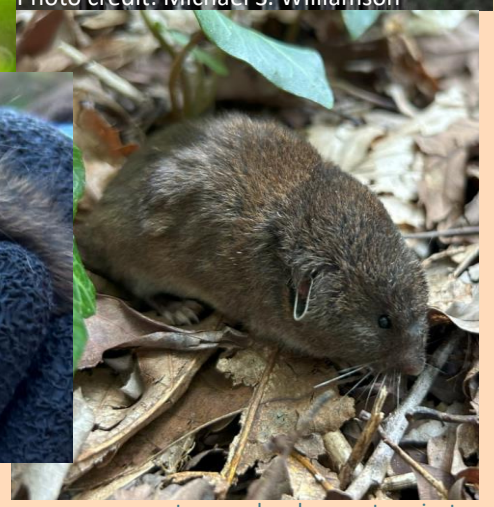
Project overview

- My thesis project involves understanding how urbanization might cause genetic and morphological differentiation between small mammal populations.
- **Urbanization:** increasing human population density and impervious surfaces
- As the human population continues to grow, natural areas will become more fragmented and potentially affect wildlife populations and the risk of zoonotic disease.


Photo credit: Michael S. Williamson

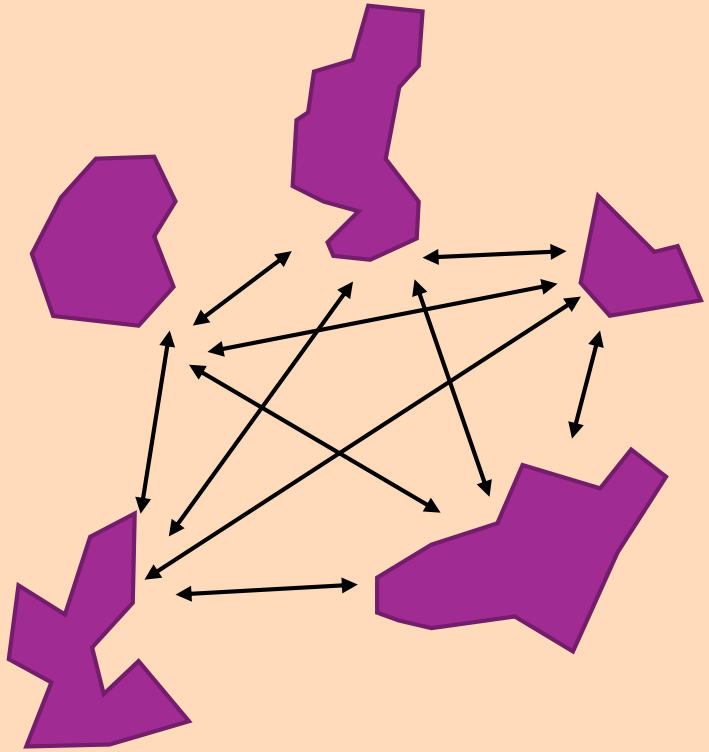


Images: https://atlanta.urbanize.city/post/before-after-atl-skyline-midtown-downtown-grown-recent-years-development-projects

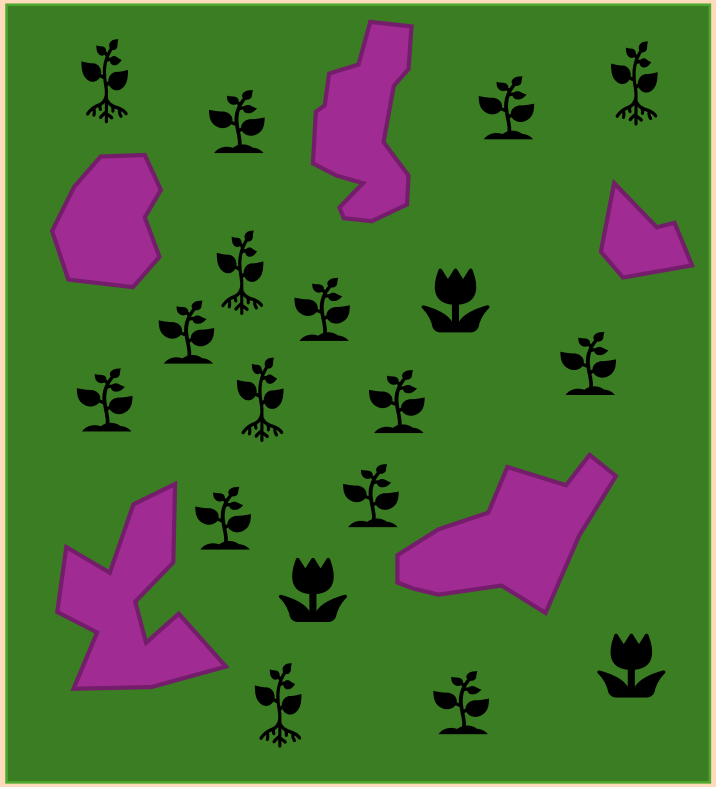
Model Species: White-footed mouse

- The model species for my project is the white-footed mouse (*Peromyscus leucopus*), due to their abundance and importance to the ecosystems they live in.
- They serve as the primary prey item for many predators, seed dispersers, and invertivores which is what makes them so crucial to the forests they inhabit.
- *P. leucopus* may be vulnerable to fragmentation in urban settings due to their limited ability to cross impervious surfaces such as roads.

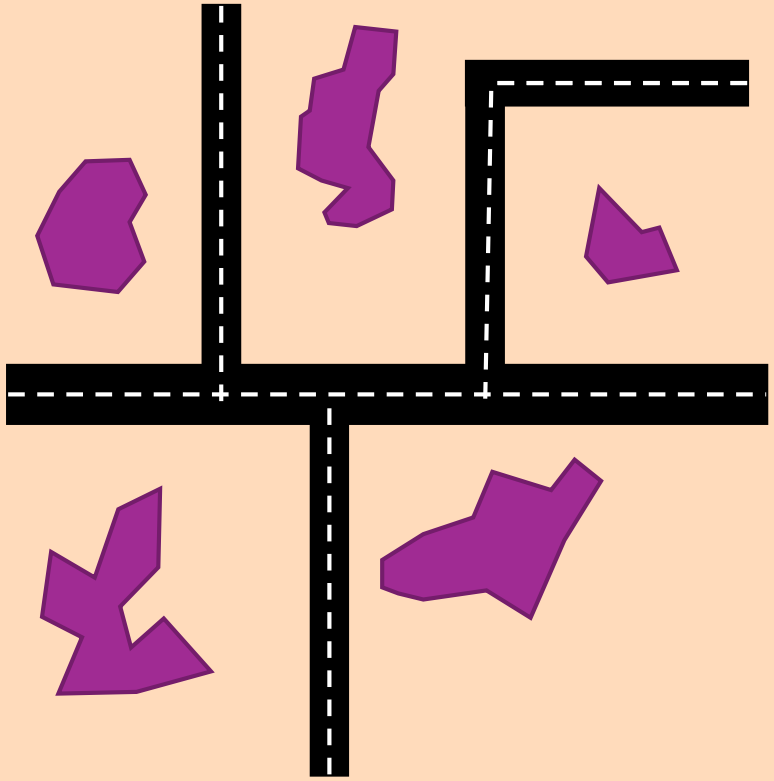
Possible effects of urbanization



Isolation by distance



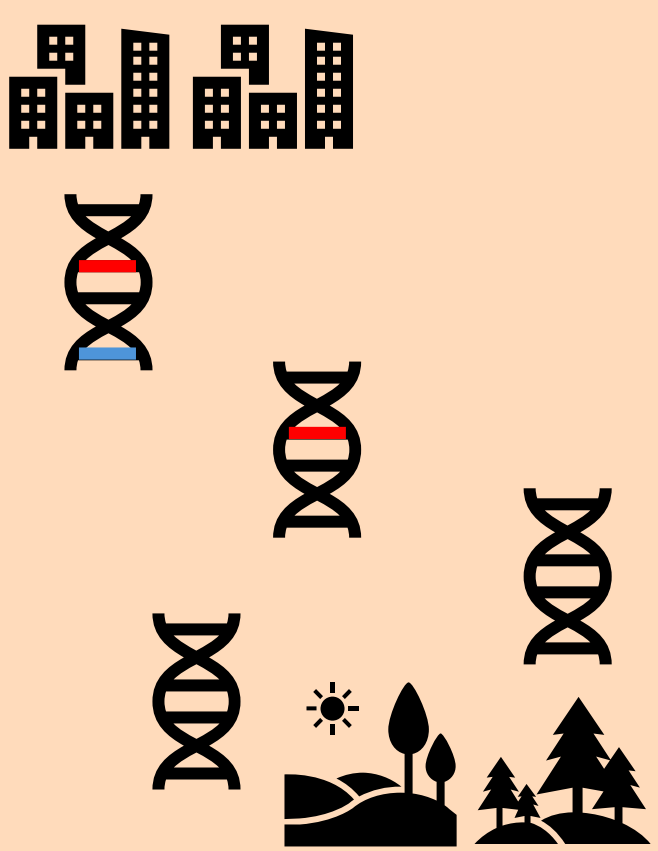
Isolation by environment



Isolation by resistance

Objectives and hypotheses

- **Primary objective:** Determine how small mammal morphology and population genetics are affected by urbanization.
- **Hypothesis:** Urbanization increases morphological and genetic differentiation beyond what is expected due to distance alone

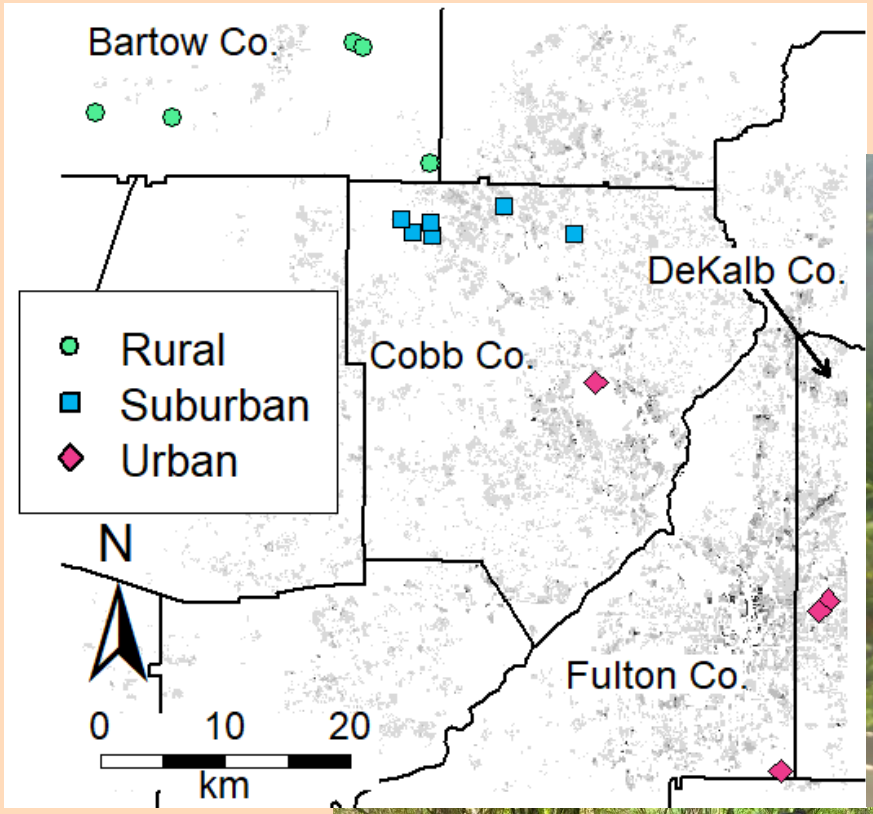


Genetic variation

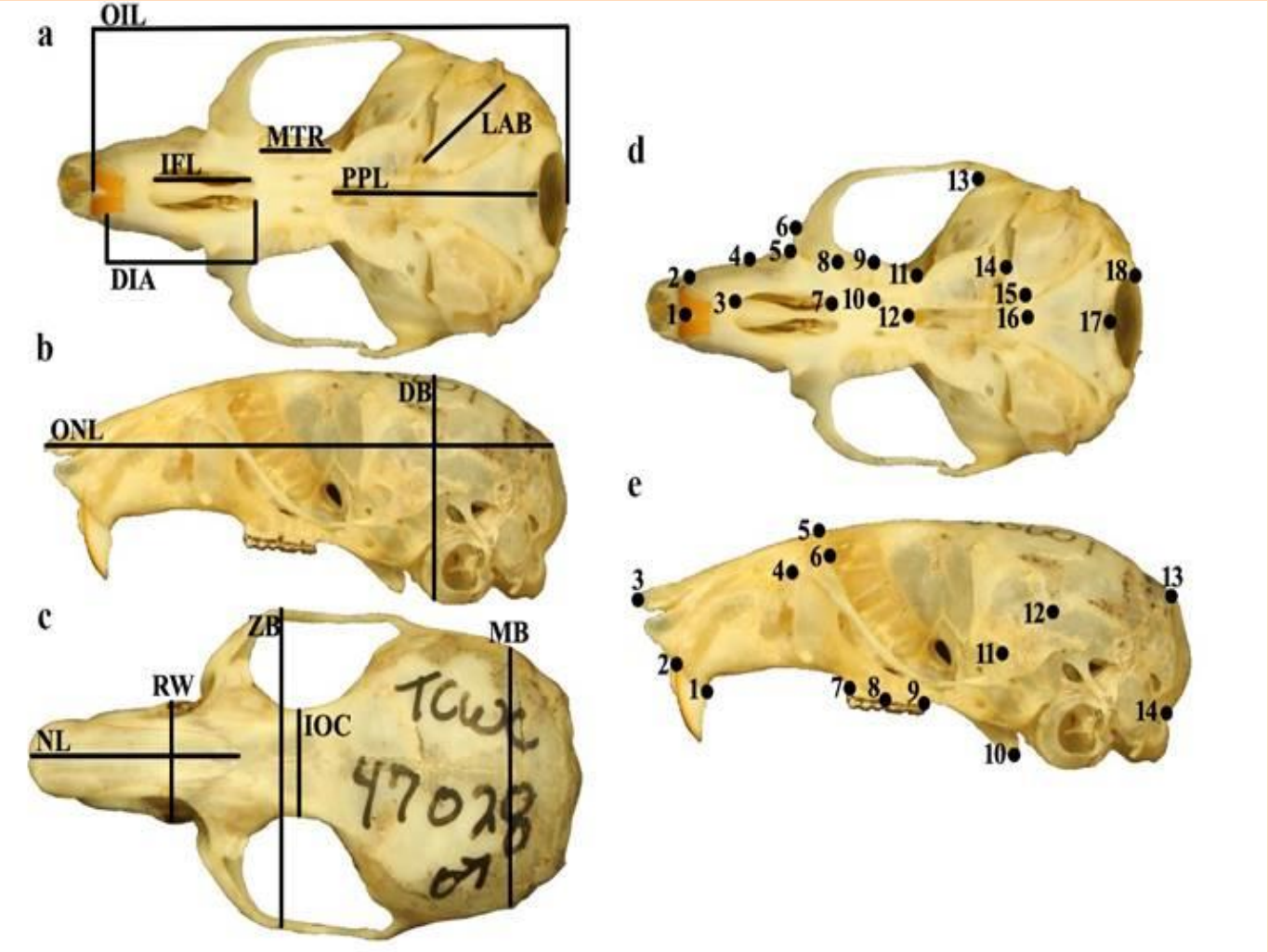
Morphological variation

Field methods:

- Sampled 17 sites from April-July 2024
  - 5 rural, 6 suburban, 6 urban
- Captured individuals were identified, weighed, tagged, measured (total length, hindlimb, pinna, and tail), assessed for sex and reproductive status and then released
- Collected ear tissue samples from *P. leucopus* caught at every site
  - Total: 203 tissue samples
  - Extracted DNA from tissue samples for population genetic analysis
- Collected 61 specimen across all sites for skull analysis

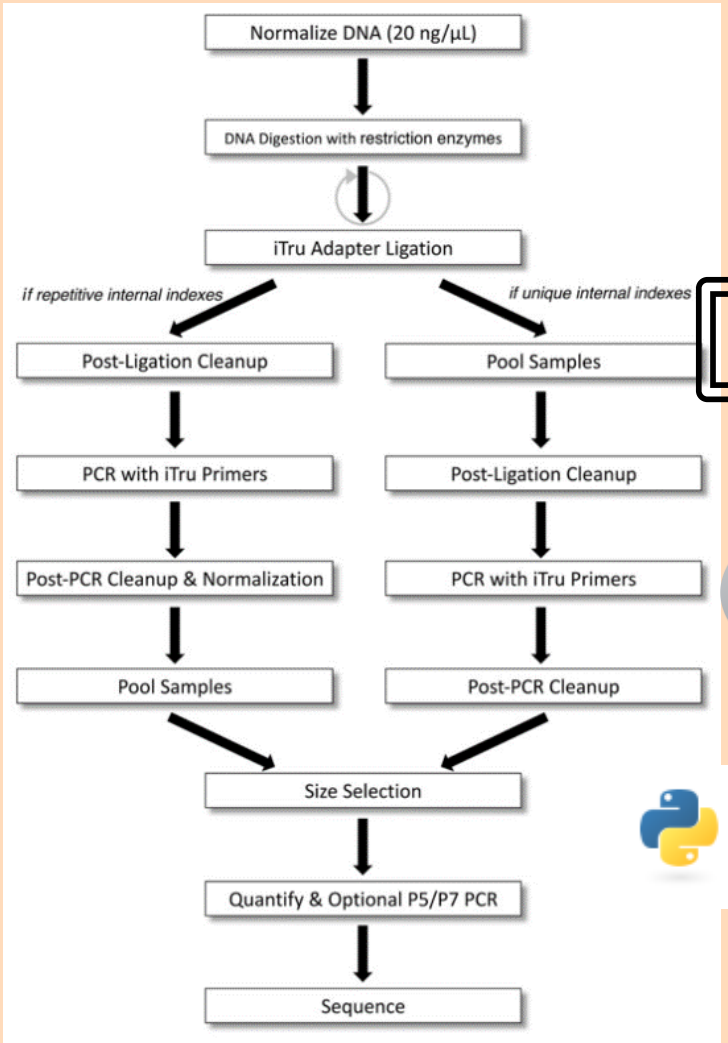


Skull morphology:



Measurements (left) and landmarks (right) for morphometric analyses in species of *Peromyscus.*
Source: https://doi.org/10.12933/therya-21-1116

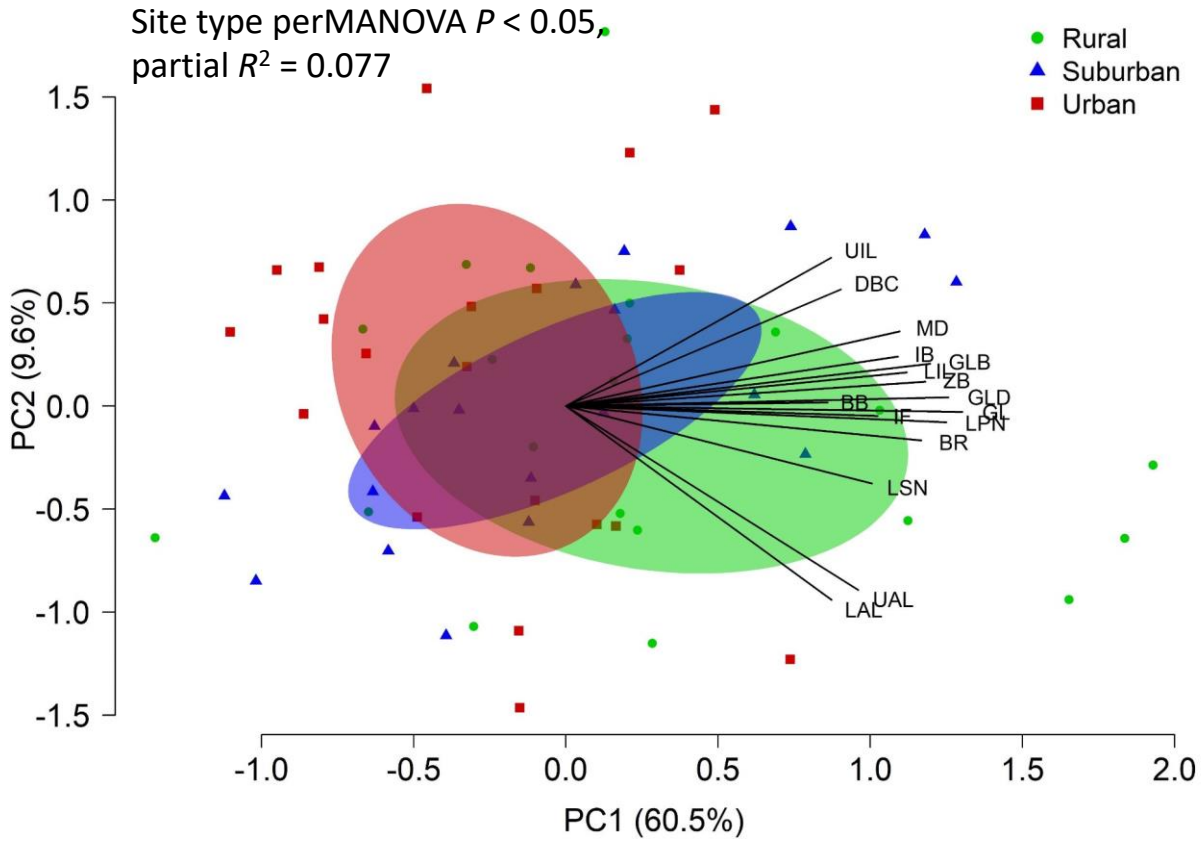
Population genetics:



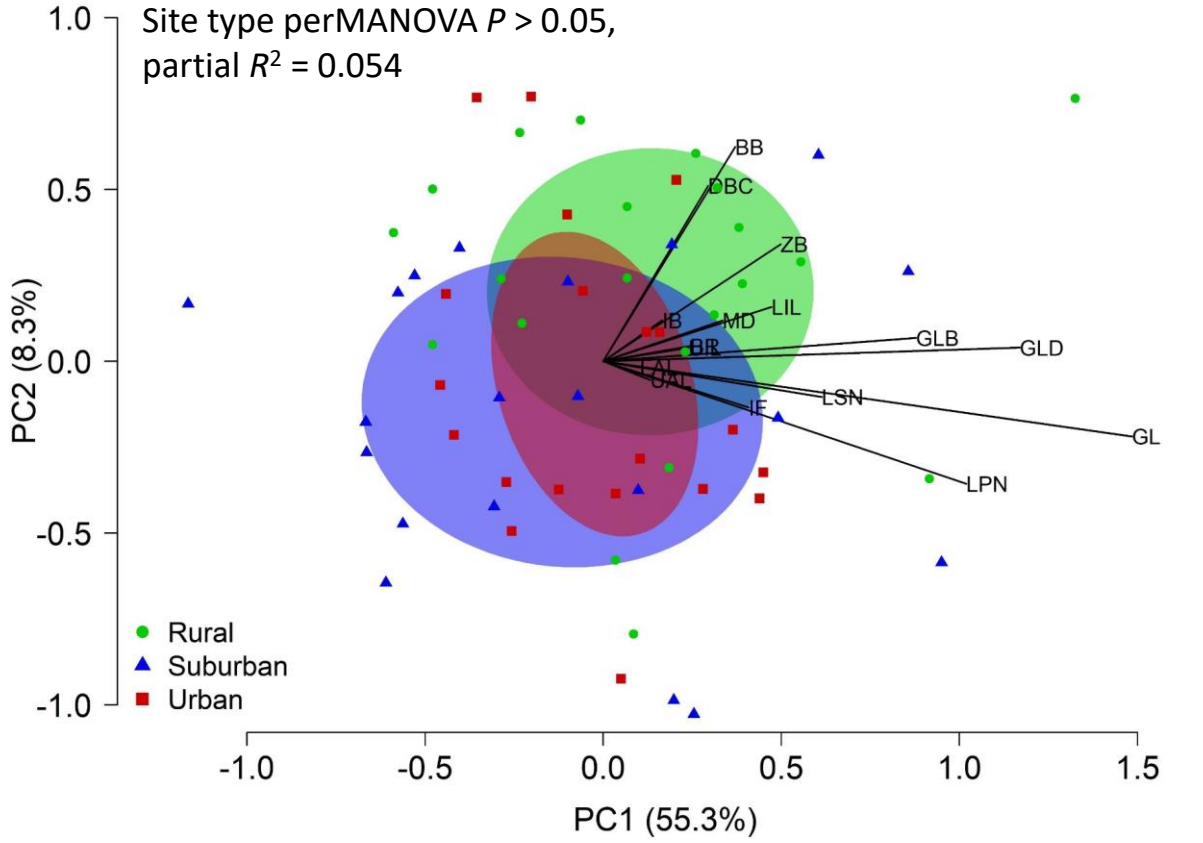
Original image: Bayona-Vásquez NJ, Glenn TC, Kieran TJ, Pierson TW, Hoffberg SL, Scott PA, Bentley KE, Finger JW, Louha S, Troendle N, Diaz-Jaimes P, Mauricio R, Faircloth BC. Adapterama III: Quadruple-indexed, double/triple-enzyme RADseq libraries (2RAD/3RAD). PeerJ. 2019 Oct 11;7:e7724. doi: 10.7717/peerj.7724. PMID: 31616583; PMCID: PMC6791345.

Linear Skull Morphology Results

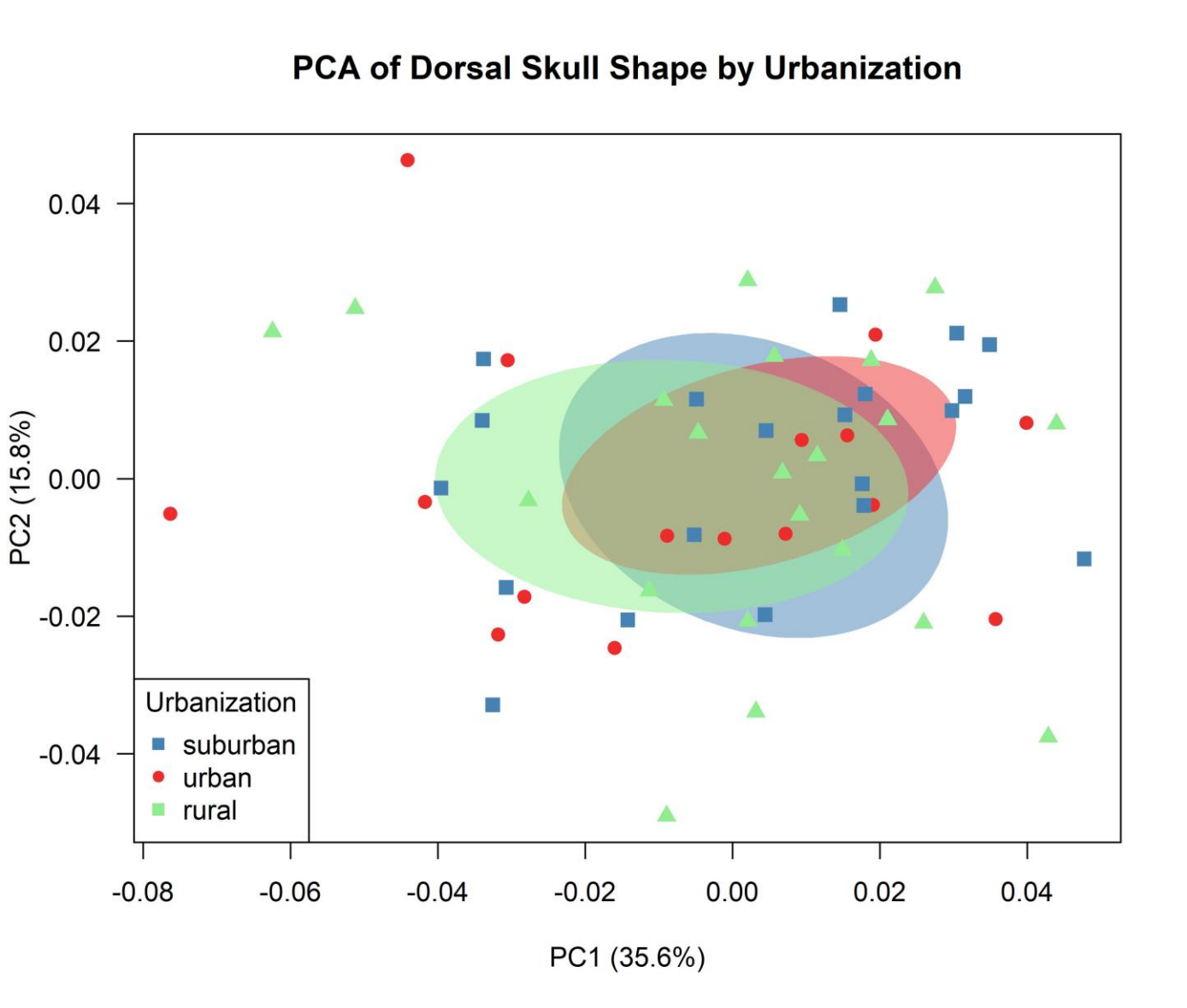
PCA of skull measurements

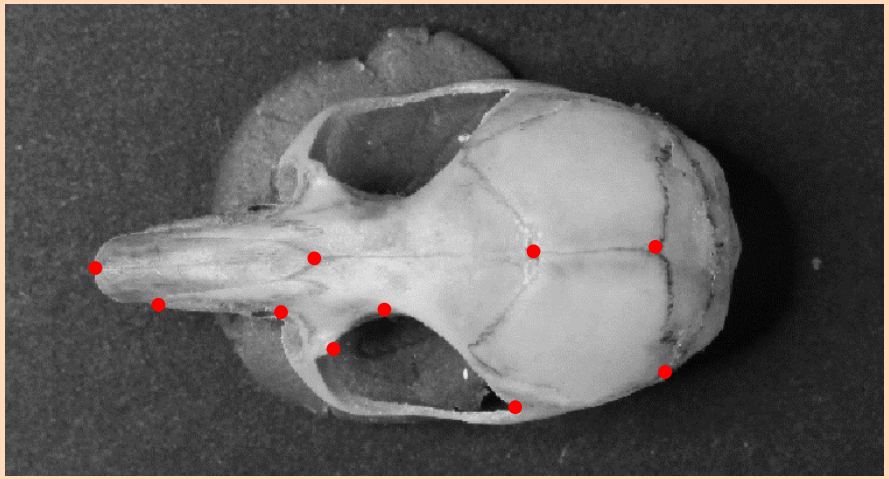


PCA of size-corrected skull measurements

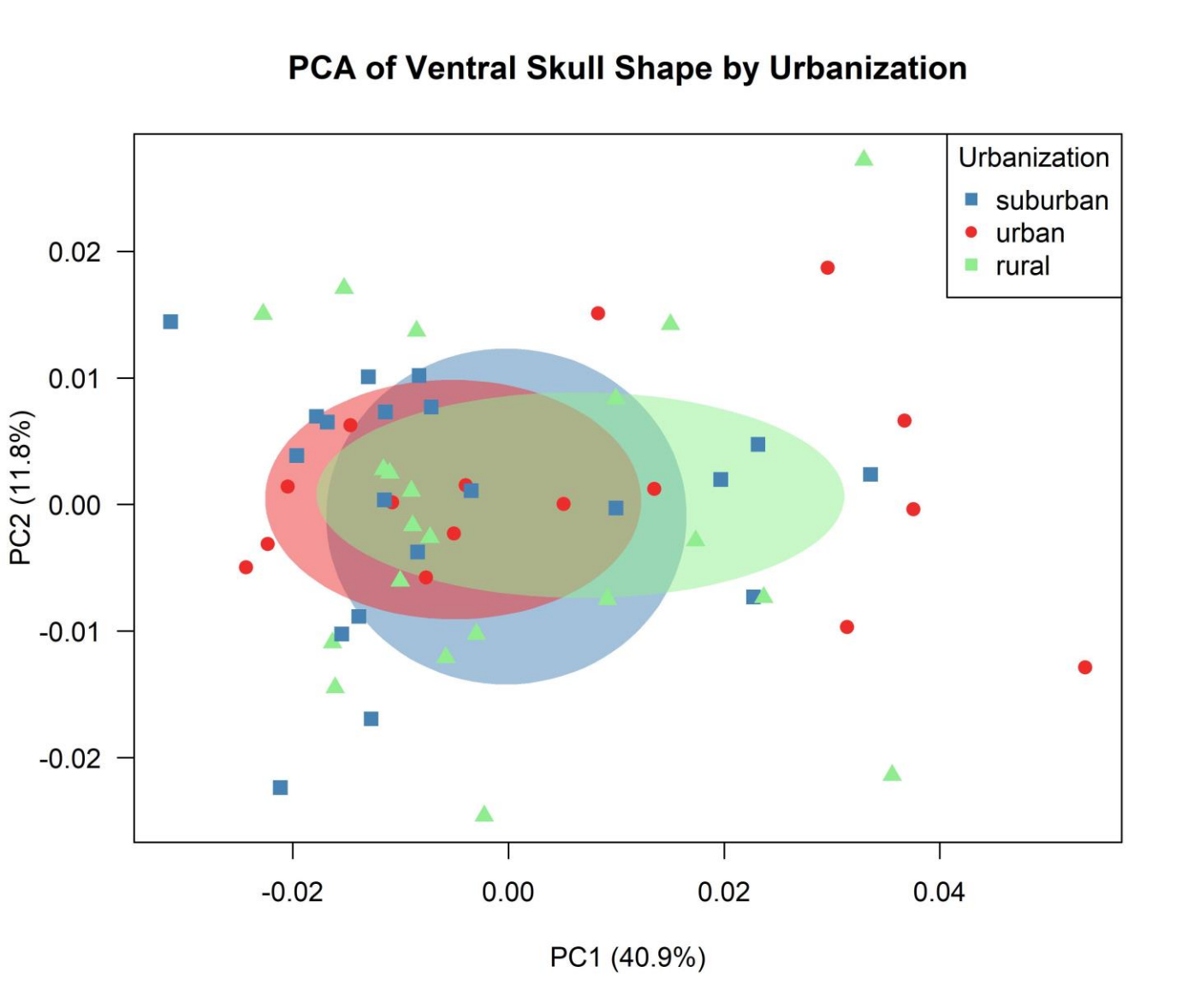


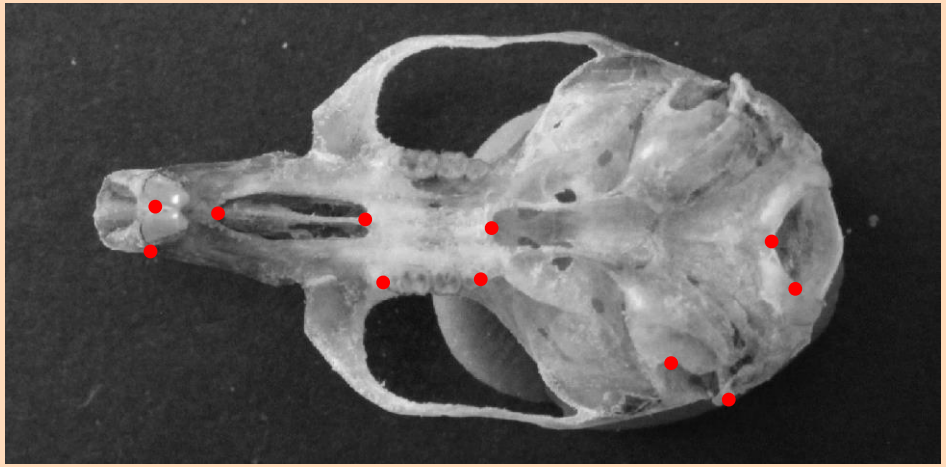
Skull Shape Results - Dorsal



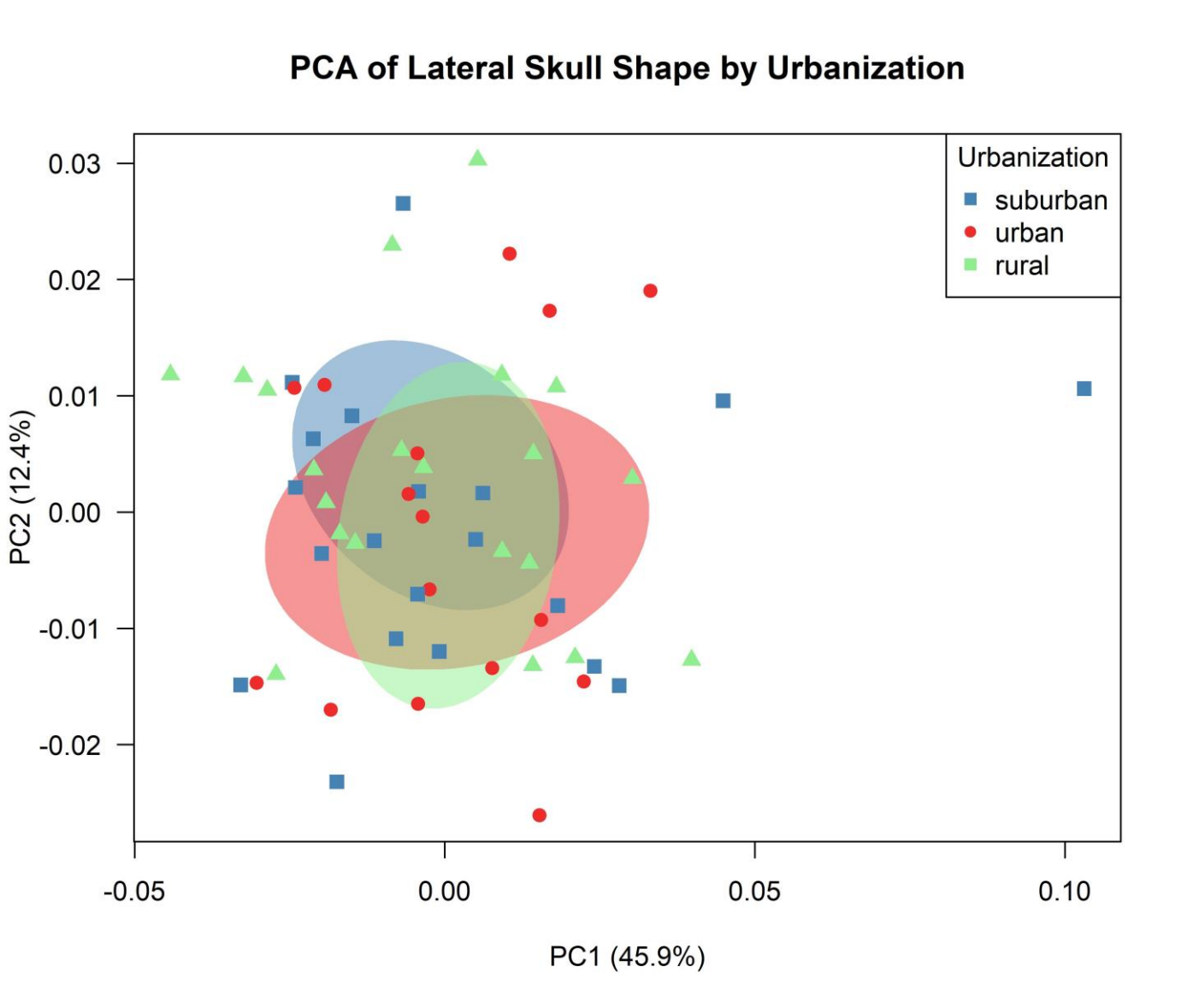


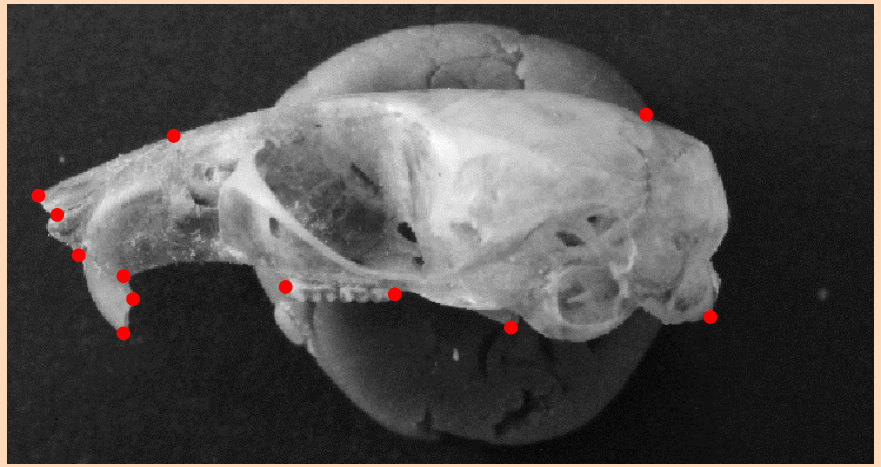
Skull Shape Results - Ventral



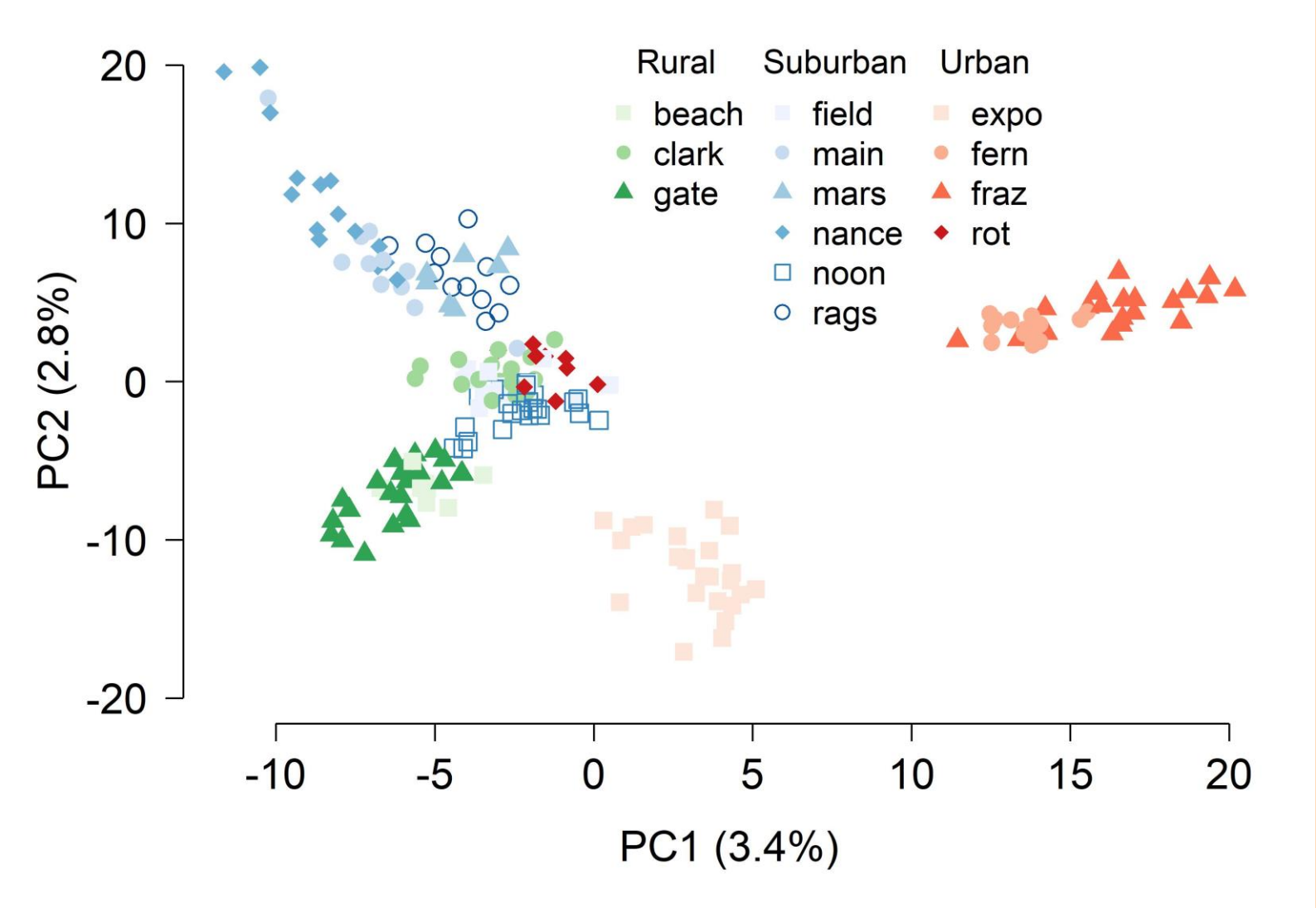


Skull Shape Results - Lateral



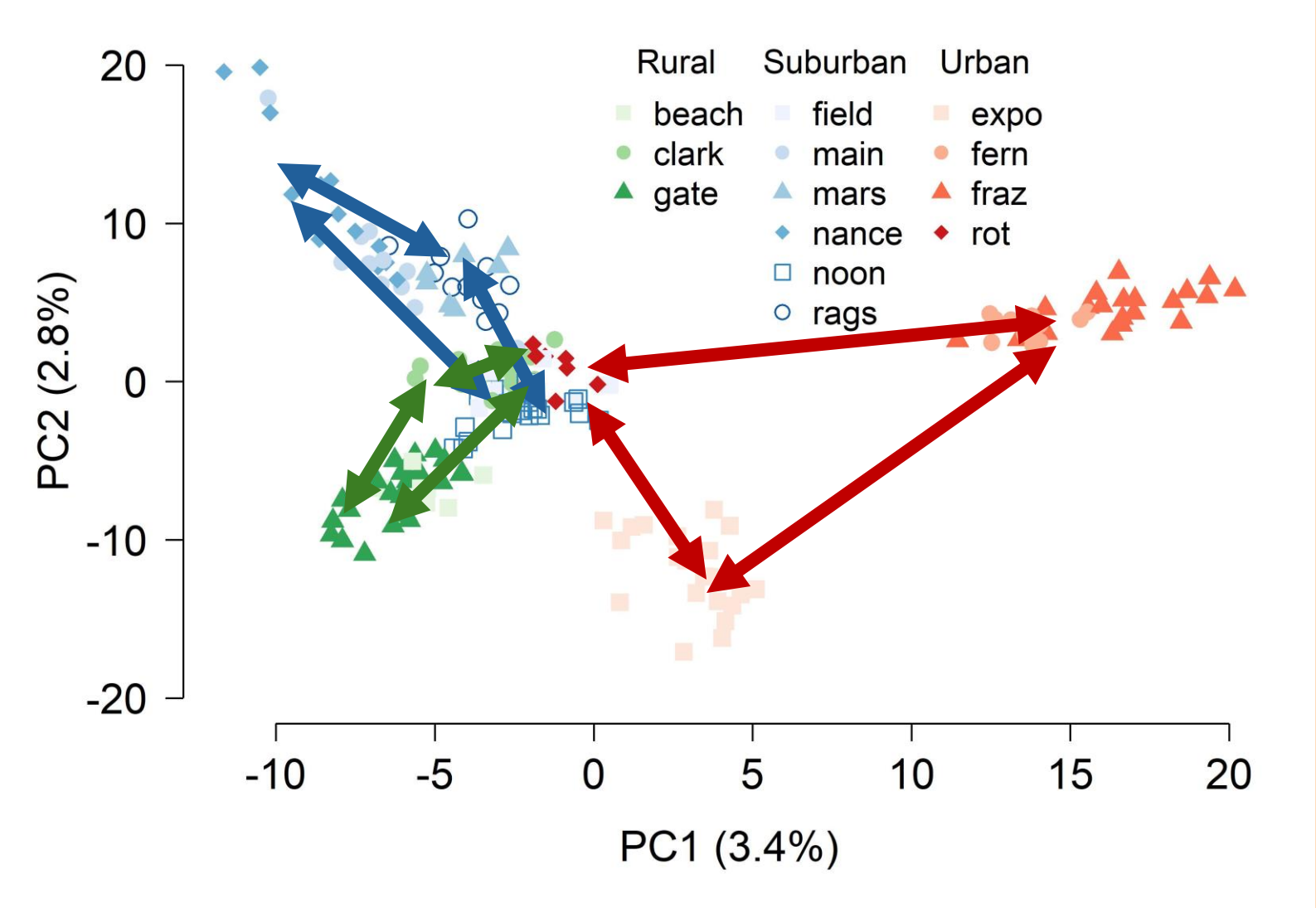


Preliminary genetics results



- Individuals cluster by site, and sites largely cluster by urbanization status
- May indicate subtle signals of population structure
- PC1 and PC2 explain a small percentage of variation, but this is not unusual in population genetic studies
- Most variation is intraspecific, and spread across many loci

Preliminary genetics results



- Genetic distances between urban sites appear much greater than genetic distances between suburban or rural sites
- Between-site distances similar within treatments
- **Suggests** urban landscape is much greater barrier to gene flow
- Results are still preliminary

Conclusions and Broader Impacts

- Urbanization is ever accelerating, so understanding and developing mitigation and conservation efforts for small mammal populations, which often live near humans, is vital not only for the animals but for human public health as well.
- Increased pathogen prevalence in, and transmission between, genetically isolated populations could heighten the risk of disease transfer to humans, especially in urban environments.

Acknowledgements

Thank you to Kennesaw State University, our undergraduate researchers, and the organizations below for allowing us to sample on their land!

- USACE
- Cobb County Parks Department
- Georgia Power at Plant Bowen
- Frazer Forest
- Fernbank Museum of Natural History
- Atlanta Expo Center
- The Conservation Fund